THE

AMERICAN NATURALIST.

Vol. II.—APRIL, 1868.—No. 2.

NOTES ON MEXICAN ANTS.

BY EDWARD NORTON.

THE insects mentioned in the following paper were forwarded to the Smithsonian Institution from Mexico by Professor Sumichrast, with notes by him upon the habits of several of the species. It is a matter of some interest to notice, that, among over twenty species, about half of which are undescribed, not one is known in the United States, while several are found in Panama and Brazil. Yet many of them live in the temperate region of Mexico!

I have added to the statements of Professor Sumichrast some recorded accounts of several of the species already described, to show how little is really known about these curious insects, and partly in the hope that some reader of this paper may also become an observer of the species around his own home, in their varied habits and occupations and labors. In the whole insect world, only the honey-bee equals the ant in its instinct and the development of reasoning powers which appear truly marvellous in such minute creatures.

Perhaps the most striking peculiarity of the ants is their social character; assembling in companies of almost countless numbers, and yet working in harmony for definite objects;

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for while they have no recognized head or guide, they all seem to devote themselves to systematic efforts for forwarding the public good. All their energies are given to this, and for this they are ready to sacrifice their lives.

The family of ants, in addition to the males and females, which are winged and generally short-lived, presents "neuters," or workers, which are wingless and live throughout the year, and perform the labor of the community. The males and females appear in the summer only. After a certain time, when they are allowed to leave the nest, the whole society teems with excitement, and only settles back into its usual course when the superfluous members fly off in swarms to seek new homes. Of those which remain, the males soon die, while the females tear off their wings, or have them torn off by the workers. Once established, the female soon lays her eggs, which are minute, but increase in size before the larvæ burst forth. These are footless grubs, which are carefully tended and fed by the workers, with a fluid previously elaborated in their stomachs. When fully grown, these larvæ assume the dormant or pupa state, some genera forming cocoons, and some not, and soon undergo the transformation into the perfect insect. These larvæ and pupæ are watched with jealous care by the workers, and are transported by them to different parts of the nest, or more or less exposed to the air according to the temperature. Before man can foresee the coming storm, the nests are securely closed, and ere the skies are fairly cleared, their labors are resumed. The bodies of other animals, the juices of plants, and even the sap secretions of other insects, such as Aphides, or Plant-lice, are taken by them for the nourishment of their helpless charges.

The workers often present two distinct forms, now called the major and minor workers, in addition to which a third set of workers is often found in one nest, which are evidently of another species, but have been captured when larvæ by the stronger species, and bred and enslaved for this purpose.

On this point but little is recorded as yet in this country,* but we have abundant testimony from observers of European species.

The major workers are usually of large size, and have the head greatly developed, but are comparatively few in number. Their duties in the society are not clearly understood, but they are supposed to have some kind of superintendence over the rest.

In the following descriptions I have thought best only to mention one or more of the prominent external characteristics by which the genera of the species here mentioned may be known.†

Subfamily Formicidæ.

In the genus *Formica*, the node, or knot-like segment between the thorax and abdomen, forms a smooth, oval or globular mass, and there is no sting.

Formica esuriens Smith. "This is very common in Orizaba and Cordova. It lives in great numbers in dead trees, in which it tunnels galleries, or under stones." From its form this should be grouped with our large black Formica Pennsylvanica, which lives in dead trees. It is not by any means certain that the species living in dead wood perforates that which is living. It seems much more likely that it occupies the channels already opened by the grubs of various borers, and helps to complete the work partly done for it. In this region the worker remains in a torpid state

*See Mr. J. A. Allen's "Notice of a Foray of a Colony of *Formica sanguinea* Latreille, upon a Colony of the black species of Formica, for the purpose of making Slaves of the latter." Proceedings of the Essex Institute, Vol. V, p. 14, 1866.

†The Ant-family, *Formicidæ*, has been separated into three subdivisions, having the following prominent external characteristics: —

Formicidæ. — The first segment of the abdomen forming a single node. (See Fig. 3 *a*, showing the spinose node of Polyrhachis.) Not provided with a sting.

Poneridæ. — The first segment of the abdomen with one node. Provided with a sting.

Myrmicidæ. — The first segment of the abdomen with two nodes. Provided with a sting. From this last, two more subfamilies have been separated, — the *Attidæ*, the major workers of which have enormously developed heads, and the *Cryptoceridæ*, the heads of which are flattened, so that the expanded sides wholly or partly conceal the eyes. They are stingless.

in decaying wood in midwinter. Dr. Fitch has described a smaller species (*Formica Caryæ*) which inhabits hickory trees, boring its passages, as he thinks, in the living wood. The wood on the sides of these passages is much discolored and softened, probably by an acrid fluid (formic acid) emitted for that purpose by the insects.

Formica fulvacea. (Fig. 1, worker major.) "Taken in Cordova, where, in the woods, it ordinarily makes its nests in the middle branches of Bromeliaceous parasites."

Formica nitida. "Inhabits the mountains of Orizaba, where it lives in little companies under the bark of pines."

Formica nacerda. "Orizaba and Cordova. Found upon leaves of plants."

Tapinoma. In this genus the node is usually received into a depression at the base of the abdomen proper, so that at first sight it often seems to be entirely wanting.

Tapinoma piceata. "Potrero (near Cordova.) In the wood of oaks."

Tapinoma tomentosa. (Fig. 2, worker; the antennæ imperfect.) "Orizaba. In little societies under stones."

Polyrhachis. This genus has the node of the peduncle thickened and usually spinose (whence the generic name from the Greek, meaning *many-pointed*), having two, three, or four spines. The thorax is usually more or less armed with spines or hooks.

Polyrhachis arboricola. (Fig. 3, worker, 3 *a*, side view of thorax and abdomen.) "Mexico. Indigenous in the hot region, where it is very common. Its nest is ordinarily placed in the cracks or apertures of large trees. It often chooses the abandoned nests (*Comejens*) of the White Ants, or Termites. (In these Comejens, which are often very large, sometimes dwells a little species of Paroquet, the *Conurus Aztec* Somm.) It is quite vagabond in its habits, and one sees it running around on the trunks of all sorts of trees and leaves of shrubs, which strongly proves it to be essentially a tree inhabitant. It causes no trouble on plantations."

Subfamily Poneridæ.

Ponera. This genus, which is allied to the "Driver Ant" of the west coast of Africa, is known by having the node of the peduncle thickened, nodiform, with the first segment of the abdomen more or less constricted. In the anterior wings there are one marginal, two complete submerged, and one discoidal cell. All the tibial spurs of the tibiæ are pectinate, or comb-like.

Ponera strigata. "Temperate region of Mexico, under stones."

Ponera pedunculata Smith. One worker was received from Mexico. This species has previously occurred at Panama and at Rio.

Ectatomma. This genus is known by the thickened node of the peduncle, and the deep constriction between the first and second segments of the abdomen. The antennæ are inserted low down at the base of the clypeus; the eyes are placed above the middle of the face, while the spurs of only the anterior tibiæ are pectinate.

Ectatomma ferruginea. (Fig. 4, 4 *a*, side view of peduncle of the abdomen.) "Mexico. This species is only found in the *encinales*, or oak forests of the hot and temperate region, where it lives in little societies under the trunks of fallen trees." The male differs very greatly in its antennæ and the form of the thorax from the worker. Mr. Smith has noted and figured several such cases. But this species seems peculiar in the division of the metathorax.

Subfamily Myrmicidæ.

In the genus *Eciton*, the peduncle consists of two nodes. The males and females are unknown. Both kinds of workers have very minute eyes, which are absent in some species. In several species the major workers have very long mandibles curved at the end, but without teeth.

Eciton hamata Fabr. "Rio Atoyai, near Cordova." This is also found in Brazil and Cayenne. The two kinds of

workers in this and the succeeding species have been previously described.

Eciton Mexicana Roger. (Fig. 5, worker major, 5 *a*, front view of head showing the immense sickle-like mandibles, and only the two basal joints of the antennæ. Fig. 6, worker minor, with a front view of the head, showing the mandibles of the usual size.) "Cordova, Orizaba, etc."

Eciton brunnea. "Occurs at Cordova, Orizaba, etc."

Eciton Sumichrasti. (Fig. 7.) "Cordova, Orizaba, etc. All the researches that I have made up to this time to discover the *formicarium* of the Eciton, have been fruitless, and I cannot obtain any information from the natives where these insects are common. At one time only (May, 1865) I found under a fallen trunk a prodigious number of workers of *E. Mexicana*. They were heaped and piled upon each other like the bees in a swarm. Attacking them with the end of a stick, I obliged them to disperse, but could find no entrance which they concealed, no eggs, no males nor females.

"Especially before a storm, or after a stormy rain, one meets travelling bands of *Eciton*. Their march is generally conducted in excellent order, and with a file of one or two individuals in front. Sometimes, however, the column enlarges itself, scatters and attacks with fury the passer-by, who, by ill-luck, has disturbed the procession. The *E. Mexicana* especially seems naturally very irascible, and the entomologist who wishes to enrich his collection with specimens of this species, must take his time and protect his legs from an attack.

"I only find the individuals with long mandibles (those which Smith calls *major workers*) among the *E. hamata* and *E. Mexicana*. It is difficult to satisfy oneself as to the role which they fill in the community. I have watched with attention the passage of columns of Eciton, but could see nothing to indicate any peculiar attributes to these individuals.

"The Eciton does no harm to agriculture by depriving the

trees of their leaves, like the Œcodoma. On the contrary, it destroys, probably, a host of noxious insects, and so recommends itself to planters; while it merits the attention of entomologists by the singularity of its habits, and the obscurity which yet reigns about its history."

In relation to the duties of these major workers with long mandibles, Mr. Bates writes (British Museum Catalogue of Hymenoptera, Vol. VI, p. 149) of a South American species: "I am quite convinced that these large-headed ones are a distinct order of individuals in a colony of Ecitons, and fulfil some distinct, peculiar functions." "I once saw on a beach a dense column of Ecitons descending from the rocks on one side of the harbor, traversing the beach and climbing again on the opposite side; the length of the column visible was from sixty to seventy yards, and yet there was no appearance of the van or the rear of the army. It was probably a migration, as all the small-headed individuals carried in their mandibles a cluster of white maggots, probably larvæ of their own species." "The large-headed individuals were in proportion of perhaps about five in one hundred to the small individuals, but not one of them carried anything in its mandibles. They were all trotting along outside of the column, and distributed in regular proportion throughout the whole line, their globular white heads rendering them quite conspicuous among the rest, bobbing up and down as they traversed the inequalities of the road."

All of the Ecitons seem to prey upon living objects. It seems probable that animal food is converted into nourishment for their larvæ by comminution, as in other species is the case with vegetable matter. Mr. Bates observes "that with most species observation is a difficult matter, for no human endurance can sustain their overwhelming attacks, the cruel sting and bite of these formidable insects." They generally march in columns. One South American species, the *E. prædator*, hunts in dense masses. "The entire phalanx, when passing over a tract of open ground, occupies

a space of from six to ten square yards; where they pass, all the rest of the insect world is in commotion and alarm. They stream along the ground and climb to the summit of all the lower trees, searching every leaf to its apex." They are often seen with the larvæ and eggs and remains of other ants, doubtless the result of attacks upon their nests. Their own nests have never yet been discovered.

In one case he thus chronicles the result of his examination of *E. legionis*. One evening he discovered a column of them at work. The next day he found them again not far off. They were mining in a bank of light soil, and extracting therefrom a bulky species of Formica, with their larvæ and eggs. It was curious to see them crowding around the orifices of the mines, and assisting their comrades to lift out the bodies of the luckless ants; the latter being too bulky to carry were torn to pieces, and the marauders forthwith started off laden with their booty. "For some distance there were many lines of these moving along the declivity of the bank, but at a short distance these converged. I then traced them to a large and indurated and ancient termitarium; up the ascent of these the Ecitons were moving in a dense column, like a stream of liquid metal; many were now lugging up the bodies of the Formicæ, and the whole disappeared in one of the spacious tubular cavities, which always traverse these old termitaria from the summit to the base."

Pachycondyla. In this genus the node of the peduncle is thickened, cubical, or nearly so, elevated to the same level as the first segment, and usually of nearly the same width. The eyes are small and inserted low down upon the head. The spurs of only the two anterior tibiæ are pectinate. (Mr. Smith says all are pectinate.)

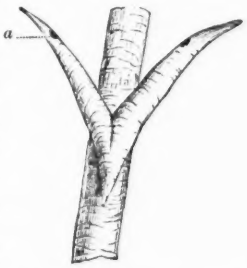
Pachycondyla Orizabana. "It lives at Orizaba in little societies under stones and trunks of trees."

Pseudomyrma. In this genus the first node is elongate, pedunculate, the second large and globose. The antennæ are inserted near together and near the mouth; eyes elongate,

ovate, occupying a large portion of the head. Anterior wings with one marginal and three submarginal cells.

Pseudomyrma bicolor Guérin. (Fig. 8. The hind legs not represented, the specimen being imperfect.) "Mexico. This is also found in Columbia and at Panama."

Pseudomyrma flavidula Smith. Mexico. This is also a South American species. I cannot feel quite sure that it is *P. flavidula*. "Among the quite numerous species of *Pseudomyrma* that one finds in Mexico, one class appears to be solitary (at least, one never meets them except alone) while the others (as is the case in *P. bicolor* and *P. flavidula*) live in greater or less numbers within the spines which arm the stems of certain species of Mimosa. These spines, fixed in pairs upon the branches, are pierced near their extremity by a hole (seen in the cut at *a*), which serves for the entrance and exit of the ants. The interior is hollow and includes some neuters, the larvæ, and, in the season, males and females. The Pseudomyrma generally stings very sharply, and attaches itself with tenacity by its mandibles to the part of the body which it seizes. Although this differs a little in size, one of these species may be considered to be the *P. flavidula* Smith."



Mr. Smith has described a species from Panama (*P. modesta*), "which lives in the hollow thorns or spines of a species of Acacia. The spines are three inches long, tapering to a point from a broad base; the ants gnaw a small hole toward the point of the spine, the broad base then forms an admirable domicile for their young brood. There are no cells or divisions of any kind for the reception of the eggs or larva. The number of pupæ found in one nest was twenty-nine, and there were about twenty mature ants. All of these were workers. The pupæ were not inclosed in cocoons."

Pseudomyrma thoracica. "Cordova. In the trunks and under the bark of trees, in societies which are sometimes very numerous."

Two other species of Pseudomyrma from South America have been observed by Mr. Bates, *P. oculata* and *P. termitaria*, which construct their dwellings in chambers in the outer walls of the tunnels of different species of Termes, or white ants. Still another species, with small colonies, constructs its formicarium in the pith-tube of dried twigs. From this variety of habits there would seem to be no definite rule laid down for the genus, as in Formica and Myrmica. Each species or group of species must be studied separately, although the whole genus may meet on common ground, as to its manner of procuring food and mode of transformations.

The genus *Atta* has two nodes in the peduncle. The wings are larger than the body, with one marginal and three submarginal cells, the third sometimes incomplete, the second bell-shaped. The large workers have greatly developed heads, and the corslet, or thorax, is without spines. This genus belongs to the subfamily Attidæ of Mr. Smith.

Atta clypeata Smith. (British Museum Catalogue of Hymenoptera, Vol. VI, p. 169.) Mr. Smith describes only the male and female. The worker minor from Orizaba, Mexico, agrees tolerably well with the description.

Another genus of this group is *Œcodoma*. It differs from Atta externally, in having the corslet armed with spines, and in the fore wings are two submarginal cells, the second being incomplete.

Œcodoma Mexicana Smith. (Fig. 9, female; 10, worker major.) (British Museum Catalogue of Hymenoptera, Vol. VI, p. 185.) "This species is unfortunately too abundant in Mexico, in the temperate departments of the gulf coast, such as those of Orizaba, Cordova, etc. The neuters are known in Mexico under the name of *arrieras*, or *hormigas arrieras*, from the similarity presented by their marching

columns to a caravan of muleteers. The male and female bear the name of *Ticatanas*. In many places the natives eat the abdomen of the females after having detached the thorax.

"It is specially in the argillaceous countries that the Œcodomas build their enormous formicaries, so that one perceives them from afar by the projection which they form above the level of the soil, as well as by the absence of vegetation in their immediate neighborhood. These nests occupy a surface of many square metres,* and their depth varies from one to two metres. Very many openings of a diameter of about one to three inches are contrived from the exterior, and conduct to the inner cavities which serve as storehouses for the eggs and larvæ. The central part of the nest forms a sort of funnel, designed for the drainage of water, from which, in a country where the periodical rains are often abundant, they could hardly escape without being entirely submerged, if they did not provide for it some outlet.

"The system which reigns in the interior of these formicaries is extreme. The collection of vegetable debris brought in by the workers is at times considerable. But it is deposited there in such a manner as not to cause any inconvenience to the inhabitants, nor impede their circulation. It is mostly leaves which are brought in from without, and it is the almost exclusive choice of this kind of vegetation which makes the *Œcodoma* a veritable scourge to agriculture. At each step and in almost every place in the elevated woods as in the plains, in desert places as well as in the neighborhood of habitations, one meets numerous columns of these insects, occupied with an admirable zeal in the transportation of leaves. It seems even that the great law of *the division of labor* is not ignored by these little creatures, judging from the following observations which I have often had occasion to make.

"The ground at the foot of the tree, where a troop of these

* A metre is about thirty-nine (39.37) inches.

arrieras is assembled for despoiling it of its leaves, is ordinarily strewn with fragments cut off with the greatest precision. And if the tree is not too lofty, one can satisfy himself that a party of foragers, which have climbed the tree, occupies itself wholly in the labor of *cutting them off*, while at the foot are the *carriers* which make the journeys between the tree and the nest. This management, which indicates among these insects a rare degree of intelligence, is perhaps not a constant and invariable practice, but it is an incontestible fact, and one which can be constantly proved.

"The part of the inhabitants which may be called the *workers*, is composed of wingless individuals of quite variable size. The largest (*workers majores* of Smith) are distinguished from the others at first sight by the great enlargement of the head, and the presence of a single ocellus upon the face. Some travellers have attributed to these *grosses-têtes*, a superior share of intelligence, and represent them as exercising a kind of surveillance over the other members of the community. I avow that I cannot come to a like conclusion, for I have always seen them devote themselves to the same labors of cutting off and transporting the leaves, etc., and this without indicating a higher development of instinct in any way. Probably their special role, if they have one, is borne in the excavation of the nest and in tunnelling the galleries, labors which demand a superior strength and better implements.

"The nest of Œcodoma serves as a habitation for many parasitic lodgers: some serpents, and particularly certain insects, which there undergo their metamorphoses. In digging up their nests in the spring, one never fails to find there some large species of Scarabæides. One also very often sees a great number of males of a wasp, *Elis costalis* Lep.,*

*Perhaps, and it is an interesting question which I have not yet had an opportunity to solve, the females of Elis deposit their eggs in the bodies of the larvæ of Scarabæus. At Tehuacan (Dep't of Puebla) where the *Scolia Azteca* Sauss. is very common, it is particularly abundant in the leather tanneries, which leads me to think that the females of this species also deposit their eggs under the epidermis of the larvæ which abound

flying about these nests, and resting themselves upon the dead branches which happen to be there, thus, I feel well assured, awaiting the coming forth from these of the females of their species which have entered into the formicary.

"At the commencement of the rainy season, after the first storms of the season, the Œcodoma begins the work of reproduction. The union of the sexes probably takes place during the night, for in the morning one finds the neighborhood of the formicary strewn with the dead bodies of the males and the females, the latter already fertile, from whom the workers make it their duty to tear away their wings.

"The ravages committed by the Œcodoma* in inhabited places, both by the surface which their nest removes from cultivation, and by the number of trees which they despoil of their leaves, are at times considerable, and demand very great watchfulness on the part of the cultivators. They have essayed a thousand ways to put an end to the havoc which these cause. The only mode which offers a sure chance of success is the removal, the extraction of the whole nest. For this purpose they dig a trench of sufficient depth around the whole, then carry away the dome or hillock and the walls of the nest, until, arriving at the cells of the larvæ, they destroy them and also the eggs. The perfect insects which escape the ruin of their colony then disappear never to return.

"The coffee plantations, which demand a light soil, are frequently chosen by the *hormigas arrieras* as places in which to construct their nests; and one can easily imagine the loss which they cause to the proprietors, if these last do not con-

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in the tan. [The *Scarabæus* is a large insect allied to our June beetle. Scolia is a wasp allied to Elis; neither have been supposed hitherto to be parasitic insects. Their habits thus probably ally them with the Ichneumon fly.—Eds.]

*"At least the Œc. Mexicana, for the *Œc. hystrix*, which also I have found isolated in the forests of the hot region, is too rare to be named as doing any damage." It may be well to add that Orizaba is in the temperate, Cordova between the temperate and hot, and Tehuacan in the cold regions or zones of Mexico. Mr. Bates remarks of the Œc. hystrix that he once "found a vast number in a low meadow, carrying away fragments of fallen fruit, but none of the large-headed individuals. This was in Brazil."

tinue an active and daily surveillance over the manœuvres of these insects."

It seems desirable to add the testimony of Mr. Bates as to the *Œc. cephalotes*, the common species of South America. "This insect, from its ubiquity, immense numbers, eternal industry, and its plundering propensities, becomes one of the most important animals of Brazil. Its immense hosts are unceasingly occupied in defoliating trees, and those most relished by them are precisely the useful and cultivated kinds. They have regular divisions of laborers, numbers mounting the trees and cutting off the leaves in irregularly rounded pieces the size of a shilling, another relay carrying them off as they fall." "The heavily laden fellows, as they came trooping in, all deposited their load in a heap close to the mound. About the mound itself were a vast number of workers of a smaller size. The very large-headed ones were not engaged in leaf-cutting, nor seen in the processions, but were only to be seen on disturbing the nest." Mr. Bates says, "I found, after removing a little of the surface, three burrows, each about an inch in diameter; half a foot downward, all three united in one tubular burrow about four inches in diameter. To the bottom of this I could not reach when I probed with a stick to the depth of four or five feet. This tube was perfectly smooth and covered with a vast number of workers of much smaller size than those occupied in conveying the leaves; they were unmixed with any of a larger size. Afterwards, on probing lower into the burrow, up came, one by one, several gigantic fellows, out of all proportion larger than the largest of those outside, and which I could not have supposed to belong to the same species. Besides the greatly enlarged size of the head, etc., they have an ocellus in the middle of the forehead; this latter feature, added to their startling appearance from the cavernous depths of the formicarium, gave them quite a Cyclopean character."

Of another species, the *Œc. sexdentata*, Mr. Smith quotes

from Rev. Hamlet Clark, that at Constancia, Brazil, the proprietor of a plantation used every means to exterminate it and failed. "Sometimes in a single night it will strip an orange or lemon tree of its leaves; a ditch of water around his garden, which quite keeps out all other ants, is of no use. This species carries a mine under its bed without any difficulty. Indeed, I have been assured again and again by sensible men, that it has undermined, in its progress through the country, the great river Pariaba. At any rate, without anything like a natural or artificial bridge, it appears on the other side and continues its course." This testimony is confirmed by Mr. Lincecum (Proceedings of Academy of Natural Sciences, Philadelphia, 1867, p. 24) in an interesting account of the *Œc. Texana*, which he has observed for eighteen years. He states that they often carry their subterranean roads for several hundred yards in grassy districts, where the grass would prove an impediment to their progress. On one occasion, to secure access to a gentleman's garden, where they were cutting the vegetables to pieces, they tunnelled beneath a creek which was at that place fifteen or twenty feet deep, and from bank to bank about thirty feet. He also observes that the smaller workers which remain around the nest do not seem to join in cutting or carrying the leaves, but are occupied with bringing out the sand, and generally work in a lazy way, very differently from the quick, active leaf-cutters. Also that the pieces of leaves are usually dried outside before being carried in, and that if wet by a sudden shower are left to decay without. He also thinks that their lives are dependent upon access to water, and that they always choose places where it is accessible by digging wells. In one case, a well was dug by Mr. Pearson for his own use, and water found at the depth of thirty feet. The ant-well which he followed was twelve inches in diameter.

The genus *Cryptocerus* belongs to another subfamily, *Cryptoceridæ*, founded on the form of the head, which is

more or less flattened above, with the sides expanded into flattened marginal plates, concealing or partly hiding the eyes. The peduncle consists of two nodes, the corslet is spinose, and the face is grooved in front for the reception of the antennæ.

Cryptocerus laminatus Smith. (Journal of Entomology, 1860, p. 77.) Brazil. "This species lives at Cordova, in the same places as the next, but it is rarer and more solitary."

Cryptocerus multispinosus. (Fig. 11.) This is the most common species of Cryptocerus in the environs of Cordova, where it lives in the trunk of certain trees, especially those of the Croton sanguiferum, Cedrela odorata, Spondias chilias,* etc. These ants show little vivacity, remaining stationary a good part of the day at the entrance of the holes which conduct to their nest. In the middle of the day one sees them running about fallen trunks, without apparent order or aim. When one attempts to seize them, they elevate the abdomen while running, after the manner ascribed to another kind of ant, the *Crematogaster Montezumia.*

NOTE.—The new species mentioned in this paper will soon be described in the Proceedings of the Essex Institute.

EXPLANATION OF PLATE II.

Fig. 1. *Formica fulvacea*, worker major.
Fig. 2. *Tapinoma tomentosa*, worker.
Fig. 3. *Polyrhachis arboricola*, worker; *a*, side view of thorax and abdomen.
Fig. 4. *Ectatomma ferruginea*, worker; *a*, side view of the peduncle of the abdomen.
Fig. 5. *Eciton Mexicana*, worker major; *a*, front view of the head.
Fig. 6. *Eciton Mexicana*, worker minor, with a front view of the head.
Fig. 7. *Eciton Sumichrasti*, worker minor.
Fig. 8. *Pseudomyrma bicolor*, worker.
Fig. 9. *Œcodoma Mexicana*, female.
Fig. 10. *Œcodoma Mexicana*, worker major.
Fig. 11. *Cryptocerus multispinosus*, worker.

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*These are local names for Mexican plants.

Fig. 1.

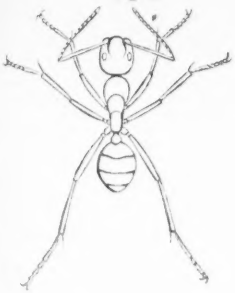


Fig. 2.

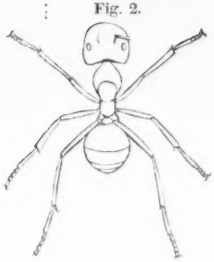


Fig. 3.

Fig. 9.

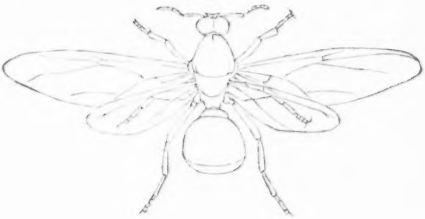


Fig. 7.

Fig. 11.

Fig. 6.

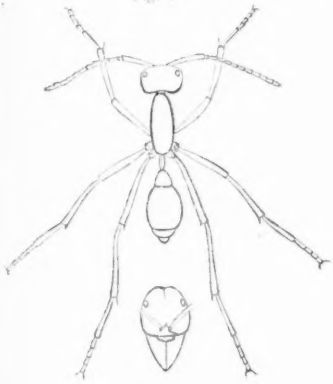


Fig. 8.

Fig. 10.

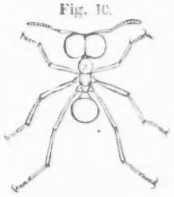
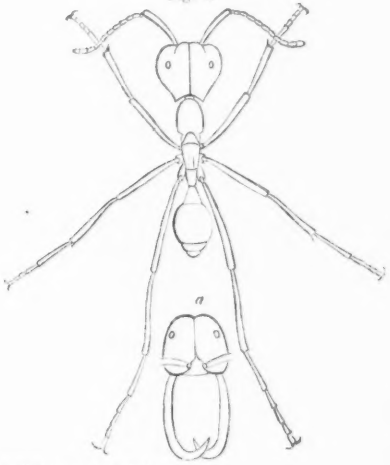


Fig. 5.



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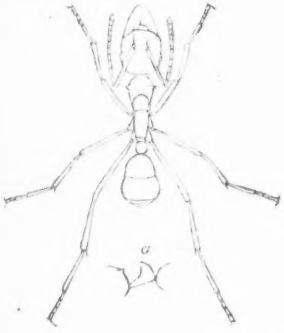

NORTON ON MEXICAN ANTS.

—THE—
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THE MOTTLED OWL IN CONFINEMENT.

BY C. J. MAYNARD.

[The following interesting account of this bird was sent me for insertion in my "Birds of North America," which I have in preparation. As it throws considerable light on the disputed question of the color of the bird's plumage in the first year, I send it to the NATURALIST, hoping that it may bring out, from other observers, new facts in relation to this species. In presenting it, I will briefly say that I have found two other birds in the first year's plumage which were decidedly gray; but these are the only instances that I have noticed, although I have examined a great number of specimens. Whether we have two species of *Scops*, or whether the young of *S. asio* are sometimes gray in color, sometimes red, remains still uncertain. My own opinion is that the last hypothesis is the most correct. — E. A. SAMUELS.]

ON June 15, 1867, I observed some boys around a small owl which was perched on a stick. On closer examination I found that it was a young Mottled Owl (*Scops asio* Bonaparte). It was staring about in a dazed manner and seemed half stupefied. I easily persuaded the boys to part with it for a trifle, and took it home. I should judge that it was about two weeks old. It was covered with a grayish down. I put it in a large cage, and gave it some meat which it ate, but not readily, for it seemed frightened at the sight of my hand, and at my near approach would draw back, snapping its beak after the manner of all owls. It soon grew tamer, however, and would regard me with a wise stare, as if perfectly understanding that I was a friend.

In a short time it would take food from me without fear; I never saw it drink, although water was kept constantly near it. Its food consisted of mice, birds, and butchers' meat, on which it fed readily. I kept the bird caged for about two weeks, during which time it became quite tame, but would not tolerate handling, always threatening me with its beak when my hands approached it. As the wires of its cage broke its feathers when moving about, and as it hardly

seemed resigned to confinement, I opened its cage and gave it the freedom of the room, leaving the windows open night and day. About this time I gave it the name of "Scops," to which in a little while it would answer, when called, with a low rattle, which sounded like the distant note of the kingfisher.

One morning Scops was missing; diligent search was made for it, but no owl could be found, and, reluctantly, we gave it up for lost. Once or twice it was seen in the neighboring woods by different people, and once on the roof of a barn, but was wild and refused to be caught. It had been absent about a week, when, one morning, I was told that my owl was out in the yard. I hastened out and found a half-grown Newfoundland dog playing with my pet. The owl was clinging to his shaggy fur with its claws, snapping its beak, and biting fiercely. I immediately rescued poor Scops and carried it into the house. It was raining hard, and the bird was wet through. On arriving in its old quarters it seemed pleased, chuckling to itself after its manner. It was almost starved, and ate two full-grown blue-birds at the first meal. After this time I gave it the privilege of going and coming when it pleased, but, mindful of its former experience, it never has but once remained away more than two days at a time. It now became more attached to me than ever, and will, at this time, permit me to pat it gently.

When a bird is given it for food, it takes it in its claws, and with its beak invariably pulls out the wing and tail feathers first, then eats the head, then devours the intestines; then, if not satisfied, it eats the remainder of the bird, feathers and all.

That this owl sees tolerably well in the daytime I have proved to my satisfaction. I caught a mouse and put it alive into an open box about two feet square. This I placed upon a bench near Scops, who was attentively watching my movements; the moment it saw the mouse, the owl opened its eyes wide, bent forward, moved its head from side to

side, then came down with an unerring aim, burying its talons deep in the head and back of the mouse. Looking up into my face, and uttering its rattling note, as if inquiring, "Is'nt that well done?" it flew up to its perch with its struggling prey grasped firmly in its talons, where it killed the mouse by biting it in the head and back. During the whole act it displayed considerable energy and excitement.

Again, I have seen it pounce on a dragon-fly which was unable to fly, but laid buzzing on the bench; the bird went through the same manœuvres as before, striking the dragon-fly with the greatest precision, and with both feet. I think that these instances prove that the bird can see nearly as well in the day as in the night. In both the above instances the sun was not shining on the objects struck, but they were very near the window, and the light was consequently strong.

Scops will, in taking birds from my hand, almost always look up in my face and utter its subdued rattle. In sleeping, it usually stands on one foot, both eyes shut, but sometimes stretches out at full length, resting on its breast. When sound asleep it awakes instantly on its name being pronounced, and will answer as quickly as when awake. I have heard it utter its peculiar quavering note on one or two occasions, which, notwithstanding its reputed mournfulness, has much that sounds pleasant to my ears. When moving along a plane surface, Scops progresses, with a half walk, half hop, which is certainly not the most graceful gait possible.

When out at night among the trees Scops acts in much the same manner as when in the house, hopping from limb to limb, looking about with a quick, graceful motion of the head, sometimes turning the head around so that the face comes directly behind.

When it returns to the house in the morning, daylight is often long passed, and even sunrise. The alarm note is a kind of low moan; this was often uttered at the sight of a tamed

gray squirrel (but with which it has now become better acquainted), and always at the sight of its old enemy, the dog.

While flying, Scops moves through the air with a quick, steady motion, alighting on any object without missing a foothold. I never heard it utter a note when thus moving. When perching, it does not grasp with its claws, but holds them at some distance from the wood, clasping with the soles of the toes. When it has eaten enough of a bird, it hides the remaining portions in any convenient place near by; if its hiding-place is then approached, the owl from its perch watches the intruder jealously, and when its hidden spoils are touched, it lays back its ear-like tufts, snaps its beak once or twice, and drops down on the unlucky hand like an arrow, striking it with its sharp claws until the hand is withdrawn; then, ascertaining that its treasure is safe, Scops resumes its perch, looking at its late disturber with most unfriendly eyes.

Sometimes in the daytime it will take a sudden start, flitting about the room like a spectre, alighting on different objects to peer about, which it does by moving sideways, turning the head in various directions, and going through many curious movements; but it always returns to its perch and settles down quietly.

I once placed a stuffed owl of its own species near it, when it ruffled its feathers, gave a series of hisses, moans, and snappings of the beak, and stretched out one wing at full length in front of its head as a shield to repulse what it took to be a stranger invading its own domains. As the stuffed bird was pushed nearer, Scops budged not an inch, but looked fiercer than ever; its ruffled back-feathers were erected high, its eyes sparkled, and its whole attitude was one of war.

Some time since the building in which my pet was kept was torn down, and the bird was absent for two weeks; but a new building has been erected near the site of the old one, and to-day I found Scops in the new cellar, sitting on a pro-

jecting stone of the wall, as much at home as in the old place. From this it can be seen that its affection for locality is very strong. Notwithstanding Scops' long absence it is as tame as ever, taking its food from my hand, and behaving in the old manner. Its plumage at this time (Oct. 31, 1867) is perfect, most of the feathers having recently changed. It is mostly *gray;* there are but few marks of red, and but a faint wash of cream-color on the back, *not red.*

In your book on the "Birds of New England" are given two instances of this bird's first plumage being in the *red;* but my bird's is decidedly in the *gray.* If it is red at all, it must be at some time hereafter. You also mention one occurrence of the young bird in the gray plumage, and, to give an additional example, I would, for the benefit of students, add one from my own experience.

ROCK RUINS.

BY A. HYATT.

I WAS accosted once by a gray-headed patriarch, sitting at the door of his farm-house, with these words: "I have heard of you, and wished to see you; my neighbors tell me that you are a rock-hunter." After many questions he continued: "I have read nothing but this,"—holding up the well-thumbed family Bible,—"and seen nothing but that,"—pointing to the extensive landscape the house afforded,—"and yet," said he, "a long life spent with them both before me, has given me more to think about than I can master. The rains pour down their floods upon these hills till every little hollow holds a muddy rivulet which empties into that silver thread you see yonder, until it too is a broad, yellow current. It has struck me, stranger, that those rains, in the hands of the Almighty, are the instruments which have cut

and shaped these hills about us, and that great valley yonder. Do you men who study rocks think so too?"

The old man, without other help than his own eyes and an appreciative love of nature, fostered by the daily contemplation of a fine landscape, had unconsciously retraced the primary steps of geological history, and rediscovered the fact that water is one of the great agents of change upon the earth's surface.

He had seen it working, and comprehended how it was slowly, but with irresistible power, melting down hills, furrowing out valleys, and casting the muddy flow through a thousand channels into the sea. The patient contemplation of a view such as one often meets with,—a quiet valley sleeping between parallel ranges of hills, with wrinkled sides and bald summits, had taught him this.

When we should wish, however, to describe the effect of water upon the face of our continent, it is not best to begin with such complicated examples, but good sense dictates the introduction of a few special cases wherein water is evidently the sole agent of change. Thus a ladder is presented to the mind by which it may climb to the comprehension of the panorama, instead of being presented at once with general laws, and then carried down backward upon the rounds of fact and explanation.

Perhaps but very few of the thousands who annually reach that Mecca of the travelling public, Niagara, are aware that it furnishes one of these examples, and is so often a theme for geological writers and lecturers. Visitors pay the extortionate prices of admission to its various points of view, are made giddy by the mad whirl of the rapids, stunned by the roar of the water, and awe-struck by the vibrations of the earth, and yet do not intelligently comprehend the meaning of all this turmoil and uproar. They read in the guide-books the meagre notice of the fact, that the cataract was once at Lewiston and has eaten its way back through the solid rock to its present position. Some accept the state-

ment as children a fairy tale, some doubt without the ability to give a valid reason, and some, fearing the sudden destruction of their dream-land, refuse to analyze the glories of the river. They shrink from familiarity with nature, lest water should prove itself nothing but water, and stone nothing but stone, entirely ignorant of the fact, that the close observer, whether poet, artist, or naturalist, is the only one who seeks the spirit of the beautiful with success. He alone grasps the internal creative thought, the soul embodied in the landscape, without which the rocks, rivers, and mountains, with their green garlands, are comparatively expressionless forms, like faces without eyes.

Along the sides of the gorge at Niagara a few of the great layers which make up the body of the continent are seen rising one after another, overlapping at the surface like tiles on a nearly horizontal roof;* the inclination of the layers, in fact, being only about twenty-five feet to the mile, in a southerly direction.

Out of the cloud and foam of the cataract appear two layers, each about eighty feet thick, the upper one (8) of limestone, the under (7) of shale. Still farther northward, above the debris that has accumulated at the foot of the cliffs, runs a thinner layer of limestone (6), and, continuing in the same direction, we find a layer of green shale (5) succeeded soon by one of light-colored sandstone (4), and lastly a mass of red sandstone (3).

Thus, when we reach Suspension Bridge it is comparatively easy even for an unpractised eye to analyze the cliff. Attracted by the emerald curtain of the great fall, few vouchsafe more than a passing glance down the chasm, and yet in autumn this view is one of rare beauty. The alternate bands of color in the rocks blend with the fringe of golden and scarlet trees upon the *talus* at their feet, and from every crevice graceful vines hang their lace-work of flaming foliage. The painted walls and their gorgeous ta-

* Vide 8, 8′, 9, and 10 in the wood-cut.

pestries rise nearly three hundred feet on either side, and, at that dizzy depth, the river glides on, a flood of green and silver, till the harder rocks in the shallower channel beyond obstruct the current and hurl its waves fifteen feet in the air.

Below the whirlpool these harder rocks appear as a light-colored, gritty sandstone (2), underlaid by a soft red sandstone (1). Even to the most superficial observer it is evident that all these layers were at one time continuous and filled the gorge, just as it is now apparent that the higher limestone and shale are continuous under the fall (*d*, *f*).

The recession of the present falls is an established fact. Father Hennepin, one of the early French explorers, described and figured Niagara as early as 1678. Then it had three distinct parts instead of two, as at present. On the Canada side a tabular rock of great size extended out interrupting and turning a portion of the overflow in an easterly direction, making a third fall at right angles, but continuous with the horse-shoe. About seventy years afterwards, a Danish naturalist, Kalm, records the disappearance of this rock, and describes the fall as having about the same general outline as at present. His sketch, however, does not differ materially from Father Hennepin's, except in the absence of the third fall. Parts of Table Rock fell successively in 1818, 1828, and 1829, and Kalm speaks of the descent of portions of this rock, which extended under the water previous to his visit in 1750.

All these changes were on the Canada side, and, as has been already noticed by Professor Jules Marcou, that part of the cataract recedes the most rapidly. The volume of water is much greater, some twenty-five feet in depth in the centre of the horse-shoe curve, and the mass of debris, which is so picturesque along the base of the American side, is entirely wanting, the layers of rock being carved out perpendicularly, probably to a considerable depth below the surface

of the river. Professor Jules Marcou, who visited Niagara in 1848–49 and 1850, remarked not only the changes which occurred in the Table Rock,* part of which fell in 1850, but observed also the increasing angularity of the curve at the centre of the horse-shoe, and the gradual deepening of the water. It seems certain that either the size of the river has greatly decreased since Father Hennepin's visit, or else this part of the horse-shoe fall is much deeper and the sides shallower than formerly. In 1850, according to Professor Marcou, the curve was passably regular; in 1863, it was very much deeper, and notched near the centre. He also noticed that a large block, some six or seven feet in diameter, which had stood near the Terrapin Tower, had been engulfed, and together with it a long line of boulders figured by Professor Hall in his map of 1842. In 1852, portions of the cliff at this point fell, making a sensible difference in its outline, and probably caused the disappearance of the boulders.

The manner in which the tables of rock are undermined is as well known as the recession of the cataract itself. Every visitor is informed that the water, dashing against the lower layer of soft shale (7), cuts out cavernous hollows like the "Cave of the Winds," and presently the projecting tables of limestone above (8), becoming too weak to support themselves, and the great weight of the river, are precipitated in immense masses to the bottom.

These huge fragments, with every point and fractured edge rounded and smoothed by the ceaseless bombardment of the water, lie in huge piles under the American fall. There is no continuous flow, but a succession of blows, and one standing near them, feeling this distinct pulsation, as wave after wave rushes over the precipice and descends with a deafening roar upon the polished surfaces, no longer wonders that the rocks are worn slippery, but rather that they

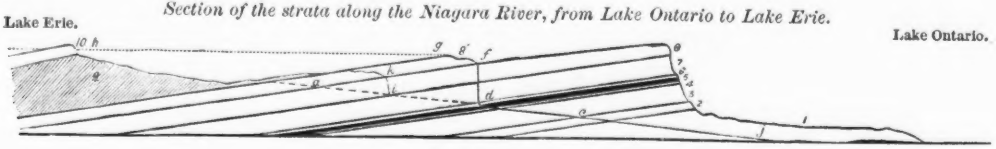
*This is a tabular extension of the upper limestone on the Canadian side close to the cataract. It once extended out some distance, and was probably the last remnant of the lateral precipice over which the third fall turned in Father Hennepin's time.

are not shattered like brittle glass under a trip-hammer, and swept away.

We must, however, even before this exhibition of power, remember that water is not the only instrument which is carving out the softer shales. Wherever these are uncovered, as in the "Cave of the Winds," they are cased in ice during the winter. Experience has taught us all how the frost loosens the bricks of the side-walks, throws down massive stone-walls, and bursts our water-pipes. All these effects are not due to any miraculous power possessed by frost, but to the fact that water when freezing expands and forces room for its increasing volume. In the crevices of the shale it acts quietly but with resistless force between the layers, like millions of minute wedges lifting and loosening the edges of the rock-beds, which are thus rendered an easy prey to the waves, if they do not fall of themselves in the early spring. Goat Island recedes almost as fast as the cataract itself, and yet frost alone is the workman that undermines its rocky face.

The future of the cataract may be read in the structure of the rocks, as well as its past. Professor Hall, who has studied it more carefully than any other geologist, predicts that Niagara is slowly but surely destroying itself. Thousands of years hence and the cataract will have eaten its way back until the solid limestone layers, which are now on its verge, will be at its base (*i*, *k*). Here it will probably remain for a long time almost stationary. The lower portion being as hard as the upper, will not be eaten out into caves and hollows as at present, but, being less exposed, will give way even more slowly than the upper limestones. These last, however, notwithstanding their hardness, will be gradually worn down, as the hard layers (2) are at the whirlpool (*c*), or the limestones on the bed of the stream above the present fall (8′) to the ascending level of the river bed, as at *d* in the wood-cut. The softer layers of greenish marl, marked 9, will have been already levelled,

Section of the strata along the Niagara River, from Lake Ontario to Lake Erie.



EXPLANATIONS.

1, Red shaly sandstone and marl, which may be seen in the bank of the river at Lewiston (*j*).

2, Gray quartzose sandstone.

3, Red shaly sandstone like No. 1 (with thin courses of sandstone near the top).

4, Gray and mottled sandstone, constituting, with those below, the Medina Group.

5, A thin mass of green shale.

6, Compact gray limestone, which with No. 5 constitutes the Clinton Group at this place.

7, Soft argillo-calcareous shale.

8, Limestone.

8′, The upper thin-bedded limestone, which, together with 7 and 8, constitutes the Niagara group.

9, Onondaga salt group of shales and marls, including the hydraulic limestone, or beds of passage to the next rock.

10, Onondaga and Corniferous limestones.

All these layers, from 1–10 inclusive, belong to the upper Silurian system.

h, *g*, *f*, *d*, *c*, *j*, This line represents the present surface of the river from Lake Erie to Lewiston, a distance of about twenty-one miles.

h, *g*, The present surface of the river, between Lake Erie and the Falls.

d, *f*, The perpendicular fall, over the Niagara limestone and shale.

f, *g*, The rapids, where within a mile there is a descent of fifty-two feet over the upper thin-bedded portion of the Niagara limestone.

c, The whirlpool.

d, *c*, *j*, Present level of the river where it has cut its way down through all the layers from 1 to 8′ inclusive.

i, *k*, The position of the falls and rapids after a recession of two miles.

a, *i*, *d*, Future level of the river bed, as the falls gradually wear away the rocky layers.

The cut and most of the explanations are from Professor Hall's Report on the Geology of New York.

and Niagara, with perhaps a slight descent over the limestones (10) at the outlet of Lake Erie, will be uninterrupted in its course to Lake Ontario.

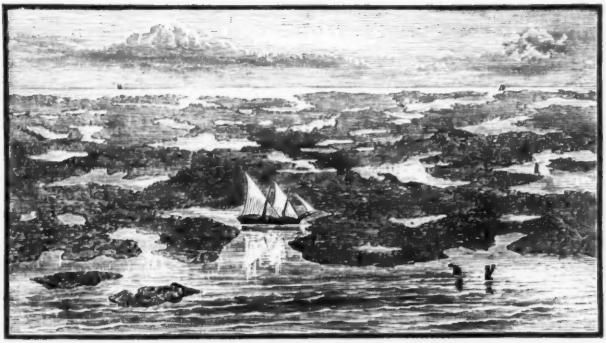
According to the estimate of Sir Charles Lyell, about thirty-five thousand years ago the falls were at Lewiston. Now they are seven miles away, and have yet two miles to traverse, each step harder and more difficult as the shale becomes thinner, before they reach the point (*i*), where, should they preserve their present structure, they will not be over one hundred feet high. Following out Sir Charles Lyell's estimate, this would take ten thousand years, even if no allowance was made for the gradual retardation caused by the disappearance of the shale. Although these calculations are based upon the observed rate of retrogression of the falls, they can only be very rough approximations, until sufficient time has elapsed for other observations to be made and compared with the monuments erected by Professor Hall in 1842. They are, however, sufficiently close and reliable to show that Niagara was not carved out in a day, nor yet in a thousand years; but that for tens of thousands of years the steady rush of the river has ground the rocks to powder, and swept away, piece by piece, the solid layers, until the gorge it has cut is now seven miles long, from two to three hundred and fifty feet deep, and eight to twenty-four hundred feet wide at the top.

Of late, the public have been alarmed by the statement that about half a mile back of the horse-shoe, the motions of the stream indicate a breach in the upper limestone, and speculations are indulged in that through this hole a subterranean stream is eating away the underlying shale with great rapidity. The sagacious inhabitants, who have given birth to this story, predict the probable destruction of the great cataract by the caving in of the tables of limestone (8′) with such rapidity that the whole will form only a rapid. It is difficult to understand, first, how such a breach could have been made; second, how if made it could swallow

enough of the river to eat away any considerable portion of the shale underneath; and third, if it did both of these impracticabilities, how the subterranean stream could break down the face of the fall faster than the water could carry off the fragments and maintain the face of the precipice perpendicular. We do not desire, however, to deprive either the guides or the oldest inhabitants of their time-honored privilege of astonishing the public, but they should remember and take warning from the fate of the "reliable contraband;" they may, even as he did, lose their hold upon the credulity of the public.

THE CRUISE OF THE "ABROLHOS."

BY C. FRED. HARTT.



RECIFE DO LIXO, ABROLHOS, AT LOW TIDE.

After one has travelled up and down the Brazilian coast and become familiar with the long sea-beaches, bordered with ridges or domes of sand, that almost uninterruptedly stretch from the Amazonas to Cape Frio, and with the ever-thundering Atlantic surf that draws its foamy line around those lonely shores, it seems strange to see at Caravellas a

coast scarcely elevated above the water, and a beach washed by a sea as quiet as an inland lake. The water here along shore is very shallow, owing to the very gentle slope of the bottom, and not only for that reason is it quiet, but because very extensive reefs, lying between the main-land and the islands of the Abrolhos, break the force of the waves, and protect the coast.

I hired at Caravellas, for the exploration of the Abrolhos region, a little launch, the *Abrolhos*, and three men, the captain being a Dane, who for many years had followed the life of a fisherman among the Abrolhos reefs, and, as it will hereafter be seen, knows them perfectly.

It was a glorious morning early in last September, the month that closes the Brazilian winter, that we embarked. Up went the long, narrow, triangular sails to the short masts, Jacó blew from his big horn a few cornet-like notes, that went breaking with strange echoes through the cocoa-palm groves on the river bank below the town, and we dropped down stream. Next day, for we had been delayed at the mouth of the river, we were beating by dawnlight out of the entrance. After sticking fast on a sand-bank or two, we soon stood off towards the islands. Near the shore the water was very turbid and reddish; but leaving the land it soon became clearer, and the yellowish tint gave way to green. The sounding-line showed a depth of about sixteen metres, with a white sandy bottom, which gave to the sea a whitish appearance. There was not a cloud in the sky, and the low sun looked warmly down on the waves rippling under the last breath of the dying land-breeze.

About seven miles from the land I observed that the water ahead was spotted by dark brownish patches of color, irregular in outline, and resembling the shadows cast by little clouds. Occasionally one might mark the breaking of a wave over one of these patches. "These are the Chapeirões,"* said Jacó. This is the name given in Brazil to

* Pronounced *Shăpayróĕngs*. The singular is "Chapeirão," pronounced *Shăpayrówng*.

isolated coral structures, which are very common on the Brazilian reef-grounds. Corals grow over the bottom in small patches, and without spreading much, rise often to a height of forty to fifty or more feet, like towers, and sometimes attain the level of low tide. At the top they are usually very irregular, and sometimes spread out like mushrooms, or, as the fishermen say, umbrellas. Some of these Chapeirões are only a few feet in diameter. Two Chapeirões are seen in the foreground of the engraving of the Recife do Lixo. Professor Verrill tells me that similar structures occur also in the West Indies. We soon came up to one and passed almost over it. They were of all heights, and on the larger the waves were breaking. The sea was full of them, a perfect labyrinth, through which our skilful captain readily tacked his way. In some places a good-sized ship might sail among them, but it would not be safe to venture among them in dark or stormy weather. As we threaded our way through, Jacó and the sailors told me stories of the whale and other fisheries carried on here, of their adventures while engaged in their hardy pursuits in these waters, and how vessels sometimes ran on the Chapeirões, sticking fast by the middle of the keel, to the amazement of the captain, who found deep water all round, the vessel being perched, as it were, like a weather-cock on the top of a tower. Occasionally, I am told, the shock is sufficient to break off and upset some of the slender ones, for they are not very compact.

After a while we came out once more into open water. The reef-ground we had crossed is known as the Parêdes, or *walls*. From north to south it is fifteen to twenty miles in length, while its width varies from three to nine miles. Where we crossed it, nearly in the middle, there are only Chapeirões; but farther north, as well as farther south, there are extensive reefs laid bare at low tide over an area of many square miles; but these I did not visit until my return voyage.

On finishing my examination of the islands, of which I

have already given a description in my last article, I set out on the evening of the 12th of September to visit the northernmost reef of the Parêdes, called the *Recife do Lixo*. My plan was to cross the reef that night at high tide, and anchor in a sac or little bay on the western side, so as to profit by the low tide of the full moon of the morrow. Eastward of the islands a few miles, with a length of about nine to ten miles, and a breadth in some places of four miles, is an area over which Chapeirões grow very abundantly, forming obstructions on which many a vessel has been wrecked. They unite nowhere to form a large reef, and are rarely anywhere uncovered at low tide.

Ordinarily, vessels and steamships go outside of these reefs to the eastward, in sight of the islands. It is not easy, however, to calculate one's distance from a point at sea, and especially from a light by night, and many vessels, notwithstanding the light-house, have been wrecked upon them. West of the islands there is deep water, there are no Chapeirões, and between the islands and the Parêdes there is a channel about eight miles in width, with plenty of water and no obstructions. The safest way is to pass to the westward of the islands, when one may run close in shore, so long as the course is north or south. There is then no danger whatever, and there is a smoother sea. On the return voyage from Rio, the American steamship "South America" was, at the suggestion of the writer, taken through this channel.

Varying winds drove the launch "Abrolhos" into the region of the Chapeirões to the north-eastward of the islands. Jacó and I took turns in heaving the lead. Among the Chapeirões we found a depth of sixteen to twenty metres, and once, while becalmed, we found twenty metres alongside one Chapeirão, and three metres on top. Waiting for the wind, the hooks were used, and we soon had, floundering about below among my boxes of corals, some fine *Guaroupas*. By and by the wind freshened and we set out to cross the channel, sounding all the way, finding a depth of seven-

teen to twenty-nine metres, a bottom composed of sand and shells, and no impediment to navigation. The almost full moon made the night wellnigh as light as day.

Late at night I turned in below, and, with the sound of waves outside and the wash of the bilge-water and the occasional floundering of the not yet dead fish inside, dreamed of home, while Jacó and the men ever and anon heaved the lead, calling out the number of metres. At last the voice of a sailor was heard at the hatch, "*O Seu Carlos! O recife!*" The reef! I went hastily on deck in the moonlight. Splash went the lead. "*Dous metros*,"—only two metres of water. We are on the reef. I rolled myself in my great coat and stretched myself out on the deck listening to the splash of the lead, and gazing at the big cumulus clouds, lit up by the moon, and memory carried me back to long rides along the sea-beaches farther south, to many a bivouac under the clear dewy sky, when the slow march of the tardily gliding hours was marked by the sinking of the moon among the waving, glistening, giant fronds of the cocoa-palm, or by the Southern Cross, that, like a great hour-hand, swung round the southern pole, and with the monstrous *modinha* of the steersman I fell asleep.

"*Dez metros!*" cries Jacó, "O Carlos ! we are in the channel." The great reef of the Parêdes is deeply indented, according to fishermen, by two very irregular channels, which, entering it from the north, almost separate it into three parts, very much as the island of Cape Breton is cut up by the Bras d'Or. We had crossed the outer reef and reached the eastern channel, which is very narrow. In this way, with the sounding-line in hand, we crossed the reef, and anchored just on the inner side to wait for the morning.

The sun rose and Jacò wound his horn. Here we were just off the reef and alongside the sac for which we had steered. As the tide went down, the reef began to uncover itself, and became dry over a very large area, as far north and south as we could see from the deck of our little vessel.

As soon as the falling tide had sufficiently defined our little harbor, we sailed in, and anchored close to the reef. I took a basket with cans and bottles, and leaped on the reef, taking with me two men with a *taraffa*, a kind of round casting net, to take fish in the pools.

The reef, exposed at low tide, was level on top, and the corals, as at the Abrolhos, were generally dead and covered by barnacles, etc. It was exceedingly irregular and rugged in outline, and deeply indented by little bays. On the surface were many large pools (see sketch), in which I found beautiful specimens of *Millepora alcicornis*, *Siderastræa*, *Favia*, etc., together with two or three species of gorgonias, belonging to the genera *Hymenogorgia*, *Plexaurella* and *Eunicia*.

Turning over the loose corals in the pond, I found a host of interesting things, sea-urchins (*Echinometra Michelini*), crimson starfishes (*Echinaster crassispina* Verrill), together with many odd crabs. There is a curious little crustacean, of which there appears to be more than one species on the coast of Brazil, called the *Tamarú*. I used to be much puzzled when walking near muddy shores when the tide was down, by hearing a sharp clicking sound. The *Tamarús* are the musicians. I suppose the sound to be made in some way by the claws. These *Tamarús* are very abundant, living in the holes in the reefs, and I have more than once, when sailing over a reef, heard their musical click in the water underneath me. There is a whole group of shrimp-like crustaceans, whose hind-body is unprotected by a shell, and which are called hermit-crabs, from their taking up their abode in dead shells. I found one large hermit-crab on this reef, which was occupying a rather large shell on which was seated a sea-anemone. It is a strange companionship which has been observed to exist between other species elsewhere. The reef is not very rich in shells.

One of the men threw the round net successfully over some charming little fishes in the ponds, and we soon had a

large collection of things, which we carried to the edge of the reef. The tide by this time had gone down farther, and the water was low enough on the border of the reef to allow one to wade all over and examine it. The very edge of the reef where the waves washed at low tide is higher than elsewhere, partially owing to a better opportunity being offered for the growth of corals, but also to a luxuriant growth of serpulæ, barnacles, etc. From this line the reef slopes gently down to the edge,* where it drops down perpendicularly into deep water, as at the islands. This border, where the water was of little depth, and where the bottom was never exposed at low tide, may be at times very narrow, or even a hundred feet or more in width. It is a perfect garden of corals. Do you wonder, my reader, that the writer felt a little bit excited as he waded about, up to his waist in water, over these coral beds?

The whole reef is alive. Here is a big head of *Acanthastræa Braziliensis* Verrill. We must have that, so down we bend to tear it away from the reef. A wave goes over our head, but what of that? the prize is secured. We tug away to tear up the fronds of the gorgonias, and toss them over the edge of the reef into a pool of water. Now we fill our arms, never so carefully, with pretty pink rosettes of *Millepora nitida* Verrill, which we are careful about handling, because of their stinging properties. These are safely lodged on the reef, and we wade out once more to the very edge of the reef (never mind the sharks!). Here are beautiful clusters of the pretty *Mussa*, with which Professor Verrill has done the writer the honor of associating his name, that look like great bouquets of whitish pinks. What a pity that we cannot pluck them whole, for they break up and go all to pieces, while the polyps out of water lose all their beauty!

But I shall make this paper too long, if I stop to enumerate all the beautiful things of this garden of the sea; the

* This submerged border is seen in the sketch.

tide is coming in, and we must be in haste. We have yet time, however, for a short walk over the reef.

The tide creeps over the reef. Our specimens are transferred to the deck of the launch, and we put out of our little harbor, with a sigh that our exploration in the Abrolhos waters are ended.

The depth alongside the reef at low water varies much, being in some places but three or four, in others ten feet or more. Just alongside the reef, at least on the inside wherever I have examined it, the bottom consists of a soft, bluish, calcareous mud. The bottom usually slopes rapidly from the reef, and one may at a short distance away in some places find a depth of seventy to eighty feet. Generally the reef is bordered by Chapeirões.

Similar reefs are found a few miles farther south at Corôa Vermelha and the vicinity, but I know of none still farther southward. To the north they occur at intervals with the same characters at Itacolumis, Porto Seguro, Santa Cruz, Bahia, Maceió, and along the coast in the vicinity of Pernambuco and northward. The Rocas, a very dangerous reef lying in the latitude of Fernando de Noronha is a coral reef, and is remarkable for its annular shape, inclosing a space in the centre free from corals.

From the descriptions of the sailors, Corôa Vermelha is a coral island. The only other of any note I have seen is at the mouth of the bay of Santa Cruz. I saw a few mangrove trees growing upon it. A schooner had struck on the reef near by, and being carried over by the waves, had sunk close inside the reef. From the height to which the water reached on the mast, I estimated the height of the reef at thirty feet.

Fortunately we had a pleasant trip home, and late in the afternoon the launch was anchored off the melting-house of the Barra. A few cornet notes brought out some of the inhabitants to welcome the incomprehensible *Naturalista*, who, landing, spent the rest of daylight in examining the

carcasses of some huge whales brought in to land since his departure.

The moon rose full and round, but waned rapidly as she neared the zenith. A fine eclipse took place which was almost total. Crowds gathered on the shore to watch the moon's fading light. The *Americano* ought to be able to explain it. He is applied to. Whereupon, by the light of an antique oil-lamp in a store near by, with a big earthen water-jar to personate the earth, and a smaller one the moon, a lecture on the theory of eclipses was delivered to an appreciative audience, with heaven's blue dome for a chart.

Next day a few hundred weight of whales' bones were added to our freight, and we moved up stream. The tiled roofs and white walls and cocoa palms of Caravellas came in view, Jaco blew his horn, and, in a few moments, with the rattle of the chain from the bow, the Cruise of the "Abrolhos" had ended.

NOBERT'S TEST PLATE AND MODERN MICROSCOPES.

BY CHARLES STODDER.

EVERY possessor of a first-class microscope wishes to know what his instrument is capable of doing. To the practical worker it is a matter of much importance, for when the utmost power of his instrument is exhausted, he will know that it is a waste of time to endeavor to see more. One of the desirable and important properties of a microscope is the power to show or "resolve" very fine lines grouped together, e. g. the striation of the frustules* of the diatomaceæ. For the purpose of testing the resolving power of the microscope, the lines ruled on glass by F. A. Nobert, of Barth,

*A frustule (*L. frustrum*, a fragment) is one of the fragments into which diatoms separate.

Pomerania, have long been admitted by experts as the best known test, not only in consequence of their exceeding fineness, but also because they are ruled to a known scale, and because they are so close that physicists have asserted that it is impossible that they ever can be seen, Nobert himself being in this category; and all trials of these plates, except those to be herein mentioned, have resulted in failures to resolve the finer lines of these plates.

The Nobert test is a series of groups of parallel lines ruled on glass thus ||| |||, each succeeding group being finer than the preceding one. Different plates have a different number of groups, ruled to different scales. The one used by Messrs. Sullivant and Wormly (American Journal of Science, 1861) has thirty bands or groups, the coarsest having its lines $\frac{1}{1000}$ of a Paris line apart, and the finest being $\frac{1}{8000}$; each group or band being about $\frac{1}{2000}$ of an English inch in width, and the whole thirty occupying a space perhaps a little more than $\frac{1}{50}$ of an inch. Now it is a difficult matter for the mind to appreciate such minute divisions of space, yet it is essential, in order to estimate a little the difficulty of seeing such lines, to form some idea of their minuteness. The average diameter of a human hair is about $\frac{1}{100}$ of an inch, yet in a space only one half as great in the coarsest band of the Nobert plate there are seven lines, while in the 30th band there are forty-five.

The plate which I have used in the trials to be detailed was made in 1863. It has nineteen bands, the first being ruled to $\frac{1}{1000}$ of a Paris line, and each band increasing by five hundred, so that the 19th is $\frac{1}{10000}$.

The following table gives in the second column the fractional part of a Paris line* between the lines of each band; the third column, the decimal part of a line as marked on the plate by Nobert; the fourth, the number of lines to an English inch; the fifth, the number of the band in a thirty-band plate corresponding in fineness.

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*One Paris line = .088815 of the English inch.

	Paris line.	Decimal of Paris line.	Lines to English inch.	Corresponding No. of Sullivant and Wormly's plate.
1.	1-1000	.1001	11,240	1st
2.	1-1500	.000633		
3.	1-2000	.0005	22,480	
4.	1-2500	.0004		
5.	1-3000	.000333		
6.	1-3500			
7.	1-4000	.00025	44,960	
8.	1-4500			
9.	1-5000	.0002	56,200	15th
10.	1-5500			
11.	1-6000	.000167	67,622	20th
12.	1-6500			
13.	1-7000	.000143	78,737	25th
14.	1-7500		84,400	
15.	1-8000	.000125	90,074	30th
16.	1-8500	.000117	96,234	
17.	1-9000	.000111	101,434	
18.	1-9500	.000105	107,167	
19.	1-10000	.000100	112,668	

Has human art ever made an instrument capable of rendering lines, 112,000 to an inch, visible? If not, is it possible to do so? Is there anything in the laws of light, which renders it impossible to see lines so close, and therefore render useless the labors of the optician to improve his instruments beyond a certain point? and, as a corollary, is it decided that it will be useless for the naturalist to try to investigate the structure of tissues beyond what the best existing instruments have shown? It must be borne in mind that the power of seeing a single object is not the question, but the power of distinguishing two or more objects nearly in contact. The problem is exactly the parallel of that of the power of the telescope of separating double stars. A brief sketch of what has been done, and what opinions on the problem have been expressed by eminent microscopists and opticians is essential to a full understanding of the question.

Professor Quecket, in 1855, asserted that "no achromatic has yet been made capable of separating lines closer together than the $\frac{1}{75000}$ of an inch." "Mr. Ross found it impossible to ascertain the position of a line nearer than $\frac{1}{80000}$ of an inch." "Mr. De la Rue was unable to resolve any lines on Nobert's test plate closer than $\frac{1}{81000}$ of an inch."

Dr. William B. Carpenter, in his work on the Microscope, published in 1856, says, "Even the $\frac{1}{12}$ objective will probably not enable any band to be distinctly resolved, whose lines are closer than $\frac{1}{79000}$ of an inch. At present, therefore, the existence of lines finer than this is a matter of faith rather than of sight; but there can be no reasonable doubt that the lines do exist, and the resolution of them would evince the extraordinary superiority of any objective, or of any system of illumination which should enable them to be distinguished." In his second edition issued in 1859, Dr. Carpenter repeated the same remarks, but substituted $\frac{1}{85000}$ for $\frac{1}{79000}$, and then added, "There is good reason to believe that the limit of perfection (in the objective) has now been nearly reached, since everything which seems theoretically possible has been actually accomplished." In the third edition, 1862, he again alters the figures to $\frac{1}{84000}$, but adds nothing more.

On the other side the late Professor J. W. Bailey claimed to have seen lines as close together as $\frac{1}{100000}$ to the inch, and Messrs. Harrison and Solitt, of Hull, England, claimed to have measured lines on the diatom *Amphipleura pellucida*, as fine as 120,000 to 130,000 to the inch, and expressed the opinion that lines as fine as 175,000 might be seen with proper means.

To determine if possible the truth between these conflicting opinions, Messrs. Sullivant and Wormley (American Journal of Science, January, 1861) made an exhaustive trial of one of these "marvels of art." They state that the optical apparatus at their command was ample; it included a "Tolles' $\frac{1}{30}$ objective of 160° angular aperture,—an objective of rare excellence in all respects,—besides $\frac{1}{12}$ and $\frac{1}{16}$ objectives of other eminent opticians." They were able to obtain an amplification of 6,000 diameters. The plate contained thirty bands, as previously mentioned.

"Up to the 26th band ($\frac{1}{78000}$) there was no serious difficulty in resolving and ascertaining the position of the lines; but on this and the

subsequent ones, spectral lines, that is, lines composed of two or more real lines, more or less prevailed, showing that the resolving power of the objective was approaching its limit. By a suitable arrangement, however, of the illumination, these spurious lines were separated into the ultimate ones on the whole of the 26th, and very nearly on the whole of the 27th band ($\frac{1}{81213}$); but on the 28th, and still more on the 29th, they so prevailed, that at no one focal adjustment could more than a portion of the width of these bands be resolved into the true lines. The true lines of the 30th band we were unable to see, at least with any degree of certainty."

"These experiments induce us to believe that the limit of the resolvability of lines, in the present state of the objective, is wellnigh established," and they draw the conclusion, "that lines on the Nobert's test plate, closer together than about $\frac{1}{78000}$ of an inch, cannot be separated by the modern objective."

Although the paper of Messrs. Sullivant and Wormley was republished in the Quarterly Journal of Microscopical Science, in London, and might be considered as being a challenge to the opticians and microscopists of Europe to show what they could do in resolving the test plate, yet no report can be found of any attempts to resolve the lines until 1865, when Max Schultz (Quarterly Journal of Microscopical Society, January, 1866) described the Nobert plate of nineteen bands, and gave the results of his trials for resolving them. "The highest set he has been able to define with *central* illumination is the 9th, which is resolved with Hartnack's immersion No. 10, and Merz's immersion system $\frac{1}{24}$. With *oblique* illumination he has not been able with any combination to get beyond the 15th." It will be seen by reference to the table that Schultz saw finer lines than Sullivant and Wormley. This is the only report we can find in print from Europe.

In this country we find no published results; but Mr. R. C. Greenleaf, of Boston, and the writer were well satisfied that they saw the lines 90,000 to the inch with a Tolles' $\frac{1}{8}$ in 1863, and the next year Mr. Greenleaf saw the same lines, unmistakably, with a Tolles' $\frac{1}{12}$. Dr. J. J. Woodward, of Washington, in a communication to the Quarterly Journal of Microscopical Science, London, October, 1867, p.

253, states that with monochromatic light, and Powell and Lealand's $\frac{1}{50}$, $\frac{1}{25}$, and $\frac{1}{16}$ objectives, a Hartnack immersion, No. 11, and a Wales $\frac{1}{8}$, with amplifier, he satisfactorily resolved the 29th and 30th bands of Nobert's test plate. In a letter to the writer written since, Dr. Woodward informs me that the plate used was the *same one* used by Sullivant and Wormley, as the 30th band was the finest on that; the result did not show that finer lines could not be seen. Dr. Woodward informs me, that, since writing that paper, he has received a Nobert plate with the nineteen bands, and that the covering glass was too thick for the $\frac{1}{50}$ objective, but with all the others he was able to resolve the 17th band (101,000 to the inch); the 18th and 19th he was unable to resolve. Dr. Woodward has sent to me a photograph of the 16th, 17th, 18th, and 19th bands, taken by Dr. Curtis with the Powell and Leland $\frac{1}{25}$. In the photograph, the lines of the 16th and 17th bands may be counted with some difficulty, but if the whole band is copied, or if the bands are of the width of $\frac{1}{200}$ of an inch, there are not lines enough. The lines of the 18th and 19th bands cannot be counted in the photograph. From this it will be noticed that Dr. Woodward has resolved *finer lines* than any other observer had yet seen, so far as report gives us any information.

My esteemed correspondent, M. Th. Eulenstien, of Stutgard, Wirtemberg, writes to me, under date of Dec. 17th, 1867, "I have myself resolved the 14th band with a $\frac{1}{12}$ Powell and Lealand, and also, but less unmistakably, with No. 11 Hartnack's immersion, with oblique light." "Nobert himself has never seen with his highest powers higher than the 14th." "This will show you the continental state of affairs." Mr. R. C. Greenleaf and myself have lately tried several objectives, and the result is appended below:*

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*Wales' 1-5 ang. ap., 140°, B eye-piece, power 475 dia., sunlight oblique, . . 8th band.
Hartnack's immersion No. 10=1-14, ang. ap. 155°, power 1062, B eye-piece, light oblique, ... 10th "
Nachet's immersion No. 6=1-12, B eye-piece, sunlight oblique, ... 8th "
" " No. 10=1-21, B eye-piece, sunlight central, ... 9th "

With Tolles' $\frac{1}{6}$ immersion, angular aperture 170°, B eye-piece, power 550, Mr. Greenleaf and myself both saw the 19th band satisfactorily. Thus being probably the first ever to see lines of 112,000 to the inch, and establishing the fact of the visibility of such lines, contrary to the theory of the physicists. (It should, however, have been mentioned in the proper place that Mr. Eulenstien says that Nachet claims to have seen them by sunlight recently, which claim needs some confirmation, as his No. 10 failed so completely in my hands.

In the present month (January, 1868), Dr. F. A. P. Barnard writes to Mr. Greenleaf, that he had tried several objectives, naming a Spencer $\frac{1}{20}$ and $\frac{1}{12}$, a Tolles' $\frac{1}{10}$ and $\frac{1}{3}$, a Wales $\frac{1}{4}$, and a Nachet immersion No. 8, equal to a $\frac{1}{15}$. "The Spencer $\frac{1}{20}$, and the Natchet $\frac{1}{15}$ broke down at about the 11th or 12th band. With the Wales $\frac{1}{4}$ I got as far as ten, or perhaps eleven bands. With the Tolles' $\frac{1}{3}$ I made out distinctly ten."

In another communication he says, "the highest band I can count is the 16th." In a more recent letter to the writer, Dr. Barnard gives the count of the lines on a portion of his plate,—corresponding as nearly as could be expected to figures given in the table up to the 14th; but the 16th band he could not count satisfactorily, different attempts giving varying results. It has been said that the resolution of the lines to the eye implies the ability to count them, but this I think is a fallacy; a few lines of a group may be counted correctly, and then it becomes difficult to identify the line last counted and the one to be counted next. Let any one try to count the pickets in a fence, when the pickets are distinctly visible, say at a distance of 100, or 150 yards,

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Nachet's immersion No. 10 = 1-21, B eye-piece, sunlight oblique, ... 12th band.
Tolles' immersion 1-10, ang. ap. about 160°, B eye-piece, power about 800, sunlight central, ... 8th "
Tolles' immersion 1-10, ang. ap. about 160°, B eye-piece, power about 800, sunlight oblique, ... 12th "
Tolles' immersion 1-10, ang. ap. about 160°, B eye-piece, Petroleum, light oblique, ... 12th "
Tolles' immersion 1-10, on another occasion I saw the . . . . . 15th "

he will find this difficulty almost insurmountable. In the microscope the micrometer is an aid in counting, but in counting lines of such exquisite fineness, either the micrometer or the stage must be moved, and it is next to impossible to construct apparatus that can be moved at once $\frac{1}{1000000}$ of an inch and no more. It would require the genius and skill of Nobert himself to do it.

These trials show conclusively, that it is not the great power of the objective that is important (for in many of the trials here reported the lower powers have given the best results, and the Tolles' $\frac{1}{6}$ immersion the best on record), but it is the skill of the optician in making the instrument. I have since tried the Wales' objective *dry*, and resolved the 13th band well,—thus doing what Mr. G. did with it in water; the inference must be that Mr. G. did not obtain its best work.

NOTE.—Since the foregoing was written, Dr. Barnard has made more trials, and I am well satisfied that he has seen the 19th band with a Spencer $\frac{1}{12}$ and Tolles' $\frac{1}{5}$, *both dry objectives*. This performance fairly surpasses any thing yet done, either in this country or Europe. Dr. Barnard writes (Jan. 29), that he found that the counting of the lines was attended with the very difficulties referred to above, in addition to which there is another trouble, the whole width of a band is not in perfect focus at once; this necessitates a slight change of focal adjustment, and any change renders it extremely difficult to fix, even with the cobweb micrometer, the exact line last counted. He made five counts of the 19th band with the $\frac{1}{12}$, namely:—

1.	110,392 to the English inch.	4.	106,226 to the English inch.
2.	108,270 " "	5.	115,474 " "
3.	113,737 " "	mean,	110,820 " "

The number, according to Nobert, is 112,668. He counts for the 15th 91,545, Nobert, 90,074. Though there is apparently considerable discrepancy between the count and Nobert's figures, yet I consider it as near as can be reasonably expected when all the difficulties are appreciated. Besides, it must be remembered that Dr. Barnard gives as above the number of lines to an inch, not the number actually counted. The actual number in the 19th band should be 56.5, if the band is *exactly* $\frac{1}{200000}$ of an inch, a variation of two lines each way covers the extremes of his counting.

Mr. Greenleaf has just tried (February 7th) an immersion objective by Wales' $\frac{1}{15}$. He resolved the 10th, 11th, and 12th bands perfectly; the 13th

was doubtful. Another trial of the Hartnack No. 10 resolved the 13th band perfectly, — the 14th doubtfully.

English and American opticians name their objectives (*i. e.*, the lens or lenses placed next the object, that next the eye being the eye-piece), from their magnifying power, — thus a $\frac{1}{4}$ inch objective has the same power as a simple lens of $\frac{1}{4}$ inch focus. Continental European makers generally distinguish their instruments by numbers; the higher numbers indicating higher powers; but as each maker has his own system, the actual power of an instrument must be ascertained by trial. Instruments also often differ from their names, and they cannot generally be depended on. The theoretical power of a microscope is measured from an arbitrary standard of ten inches, — thus, a one inch is said to magnify ten diameters; a $\frac{1}{4}$ inch, forty diameters. If the standard is taken at five inches, as it is by some, then the "power" is but one half as much. The "power" of the *microscope* is that of the objective multiplied by that of the eye-piece; if the objective magnifies ten diameters, and the eye-piece ten, the result is one hundred diameters.

Angular aperture is the angle in the surface of the front lens, at which light will enter the objective, — the greater the angular aperture, the more light, and usually the greater *resolving* power.

An *amplifier* is an achromatic combination inserted in the compound body of the instrument to increase the "power" of the objective and eye-piece.

Immersion lenses have lately attracted great attention, though they were made by Amici many years since. The objective is immersed in water, — that is, there is a film of water between the front of the objective and the object, or the thin glass covering it. The effect is a great increase of light, and better definition.

REVIEWS.

The Animal Nature of Sponges.* — Many opinions have been expressed with regard to the animal nature of the sponge, which has been considered as a plant by most authors, but nothing of a reliable or definite nature had appeared before a paper by Mr. Carter in the Annals and Magazine of Natural History, for April, 1857. In this paper it was first shown that the organized layer of the sponge was made up of single-

*On the Spongiæ Ciliatæ as Infusoria Flagellata; or, Observations on the Structure, Animality, and Relationship of *Leucosolenia botryoides* Bowerbank. With two plates, and more than seventy-eight figures. By Professor H. James Clark, A. B., B. S. Memoirs of Boston Society of Natural History, June 20, 1866.

ciliated cells, which were supposed to be allied to Amœba, an animalcule, because they were seen to take in food apparently through the walls of the body, and not through any proper mouth. Professor Clark shows that *Leucosolenia botryoides* Bowerb. is an aggregation of new forms of Monads closely allied to *Monas termo* Ehren. The existence of a mouth at the base of the flagellum, a lash-like organ present in many infusoria, is demonstrated in all these forms, and all except Monas are described as possessing a hyaline calyx, or cup, surrounding the region of the mouth, like an inverted funnel. The single monads which compose the ciliated layer lining the internal channels of *Leucosolenia*, a common marine sponge, have a similar calyx, are monoflagellate (that is, provided with a single lash-like appendage), and probably have a mouth at the base of the flagellum, since they took in their food in the same manner as the *Monas termo*. The connection between Monas and its allied forms, with the higher Protozoa, or infusoria, such as Euglena, Dysteria, and Pleuronema, is shown by *Anthophysa Mulleri* which has two flagella, like the higher forms mentioned, but like Monas has no calyx, and grows in umbellate colonies like Codosiga. The direct relation anatomically and zoölogically of the sponge with these exceedingly active and beautiful forms is startling, and one sees in the great advance in the study of the Protozoa made by Professor Clark, that, after all, Ehrenberg's belief that these minute forms had a very highly complicated organization, is, like most opinions, not without a kernel of truth. — A. H.

THE PROGRESS OF ZOÖLOGY IN 1866.* — Another volume of this invaluable year-book, which is simply indispensable to the working naturalist, has just been published. We hope it will meet with much encouragement among American zoölogists. In the words of the chief editor, "The object of the Record is to give, in an annual volume, reports on, abstracts of, and an index to, the various zoölogical publications which have appeared in the preceding year; to acquaint zoölogists with the progress of every branch of their science in all parts of the globe; and to form a repertory which will retain its value for the student of future years."

The scientific part of the zoölogical literature of 1864, to which vol. 1 forms a guide, amounts to more than 25,000 pages; that for 1865 amounts to not less than 35,000 pages; and that for 1866 to about 30,000 pages. In the literature for 1865, it is estimated that about 7,000 animals are described as new to science.

In running through the 649 pages of the last volume we glean the following items of interest. — Professor Lilljeborg states in his memoir on the Rodents that about 2,300 species of Mammalia are known, namely, about 700 *Rodents*, 500 *Chiroptera* (Bats), 250 *Feræ* (including Insect-

* The Record of Zoological Literature. Edited by A. C. L. G. Gunther, M. D., 1864–'66. London, 1865–'67, 8vo, vol. 1, pp. 634; vol. 2, pp. 784; vol. 3, pp. 649. The Mammalia, Reptiles, and Fishes are reported on by Dr. Gunther; the Birds by Alfred Newton; the Insects by W. S. Dallas; the Crustacea by C. Spence Bate; the Worms, Radiates, and Molluscoida (Tunicates and Polyzoa), by E. Percival Wright; and the Mollusca by E. von Martens. The price of each volume is about $6.00 in gold. We shall be pleased to take orders for our subscribers.

ivora), 200 *Quadrumana* (Monkies), and about as many *Artiodactyla*.* — A. Müller proves that the male fox lives in polygamy, and does not assist in rearing his offspring. — A young Hippopotamus has been successfully reared in the Zoölogical Gardens in Amsterdam. — Mr. G. O. Sars refers to the contradictory statements of naturalists with regard to the ejection of water from the blow-holes of whales. He states that if the head with the blow-hole is raised above the surface of the water, nothing but air is expelled; but if, at the moment of expiration, the head is still below the surface of the water, the force of the air expelled carries a portion of the water with it, causing a more or less perceptible spray. — In ornithology, the most important fact elicited during the year is the discovery of the bones of the Dodo by Mr. Clark, chronicled on p. 614, vol. 1, of the NATURALIST. — In a work on the fossil birds of France, A. Milne-Edwards reports that all the fossil birds of the tertiary epoch can be included in the natural groups which still exist, though none of the species are identical with the living forms, and some are types of new genera. Of the quaternary period twenty-three species have been determined, only one of which, a very large *Grus*, is extinct, though as regards France, two species, *Lagopus albus*, the White Ptarmigan, and *Nyctea nivea*, the Snowy owl, both inhabitants of the arctic regions, no longer exist there, being relics of the Glacial period. — The Great Auk is supposed to have occurred of late years on the Norwegian coast, and it is supposed to have bred on Lundy Island (coast of Devonshire), in 1838 or 1839. — A commission of Dutch naturalists have reported on the Ship-worm, *Teredo*, and the means of combating its attacks. It bores into solid wood by the mechanical rasping action of the minute denticulations covering a part of the surface of its valves, the movements having been seen by M. Kater on a living animal. It has an enemy in a worm, *Lycoris fucata* Haan, which feeds upon it. As regards means of protection the commission report: —

1. It is of no use to coat the surface of the wood with any substance supposed to be impenetrable to the Teredo, as this coating will be damaged sooner or later.

2. The impregnation of the wood with soluble inorganic salts, does not prevent the animal from invading the wood.

3. The hardness of the wood itself does not offer any protection, the wood of the "gaiac" and the "mamberklak" being invaded.

4. The only means offering a high probability of protection against the animals is the impregnation of the wood with creosote. — M. Alphonse Milne-Edwards says of *Lysianassa* (Eurytenes) *magellanica* that he has compared a specimen from Spitzbergen with one in the Paris Museum, "taken from a fish's stomach near the Straits of Magellan. These two individuals seem to resemble each other very closely (*beaucoup*), and I

* Professor Owen divides the hoofed, or ungulated mammals, into *Perissodactyla* (those with an odd number of toes), and the *Artiodactyla* (including most of the ruminants), which consist of those with an even number of toes.

have only seen a difference between them of size."—The occurrence of a venomous black spider is noticed at Berdiansk, amongst the wheat at harvest time.—Guyon writes on the parasitic Flea, or Chigoe, *Pulex* (Rhynchoprion) *penetrans*, which lives under the skin of man and pigs. Among its natural enemies is the Cockroach (*Blatta Americana*). The False Scorpion (*Chelifer cancroides*) is destructive to the common Flea.—Donné gives an account of some experiments conducted for the purpose of determining the possibility of spontaneous generation (heterogeny). Pasteur replies to these observations of Donné's, stating that his experiments are not free from many sources of error, and pronounces it as his fixed opinion, that, in the actual state of science, heterogeny is a chimæra.

NATURAL HISTORY MISCELLANY.

BOTANY.

CAN LICHENS BE IDENTIFIED BY CHEMICAL TESTS?—Some interesting experiments illustrating the differences in the chemical constitution of Lichens have lately been published (Regensburg Flora, 1866; translated by Rev. W. A. Leighton, in the Journal of the Linnæan Society, of the same year) by Dr. Nylander, of Paris; and his observations have been followed by an extended application of one of the tests proposed to the large genus *Cladonia*, by Mr. Leighton (Annals and Magazine of Natural History, 1866), and by a general consideration of the described phenomena as recognizable in Spitzbergen species, by Dr. Theodore Fries (Lichens of Spitzbergen in Acta Holmiæ, 1867).

It appears, from these experiments, that Hypochlorite (Chloride) of lime furnishes "a sort of immediate analysis" of the colorable matter in *Roccella* (Archill of dyers) when applied, in solution, to the fronds; and the species which do not furnish this matter and fail therefore to exhibit the "erythrinic" reaction, or the presence of erythric acid (the case with our solitary, North American form) are of course in such way distinguishable from those which do. The same holds good in *Dirina;* in *Lecanora tartarea* (Cudbear of dyers) as compared with closely allied species, and in *Umbilicaria* and *Parmelia*, it being necessary in the latter that the inner, or medullary layer should be submitted to the test.

In like manner Hydrate of Potash is shown to effect several different reactions, according as the tissues subjected to it differ chemically. In most yellow *Parmeliei* (*Theloschistes*) and *Lecanorei* (*Placodium*) as in the red fruit of species of *Cladonia* and of *Biatora*, in *Heterothecium Domingense*, etc., the contact of the salt immediately induces a purplish tinge (supposed to indicate what has been called chrysophanic acid) and the species otherwise referable to the groups named which do not show this change (as *Theloschistes candelarius*) are thus elegantly, and sometimes

most conveniently, separable. So again, in many other Lichens (supposed now to contain usneic acid) as *Parmelia* and *Lecanora*, *Cladonia*, etc., the reaction, if it occur, is yellow, or greenish-yellow, and serves to separate, in this way, otherwise closely related forms. It is with the botanical value of these forms, sometimes so close that they were not before taken to differ even as varieties, but now assumed, and, in part at least, on no other than the kind of evidence above given, to be "species," that botanists are concerned.

I have gone through a large part of my North American and exotic Lichens in the light afforded by these experiments, and found the facts, if sometimes suggestive of more than is stated, generally clear; much clearer than the value attributed to them. Is it not indeed safe to say at once that species are not determinable, in Botany, by such tests? Dr. Fries has well pointed out the curious and significant parallelism running through *Cladonia*, wherein forms, agreeing in almost every other respect, are seen to differ, and in the same way, in their behaviour with potash; and his list of such forms might yet be extended. *C. delicata*, of the first series below, is complemented, it appears (Leighton's Cladoniæ, p. 6) by a *C. subdelicata;* and *C. athelia* bears, with little doubt, a similar relation to *C. Santensis*. Nor does there appear to be reason for estimating the value of the terms of these parallel series, as, for example,

Not tinged by Potash.	Tinged yellow by Potash.
Cladonia gracilis, ...	"*Cladonia ecmocyna*,"
Cladonia degeneranis, . . .	"*Cladonia lepidota*,"
"*Cladonia subdelicata*," . .	*Cladonia delicata*,
"*Cladonia bacillaris*," . . .	*Cladonia macilenta*,

and so on, any higher or otherwise than in *C. furcata;* wherein we are told (Leighton's Cladoniæ, p. 9) Dr. Nylander does not consider the chemical difference which he regards as sufficient to separate "*C. ecmocyna*" from *C. gracilis* as indicating anything more than "only a distinct variety." Indeed it is difficult to see why *genera* (as for instance in the groups mostly characterized by a yellow thallus and polar-bilocular spores) should not be as properly determinable by these reagents, and nothing else, as species.

The observations cited are, however, plainly incomplete; and derive from this perhaps not a little of their interest. *Parmelia perlata* is thus said to differ specifically from its var. *olivetorum* Ach., by failing to show any red tinge with Chloride of Lime; the difference already recognized being regarded as sufficiently corroborated by the new one. But *all* specimens of *P. olivetorum* are not so distinguishable, as compare the excellent ones in Welwitsch's Portuguese collection, No. 75, and Massalongo's Italian, No. 325; and the assumed organic diversity thus failing, there is left only the (in itself uncertain) merely chemical one. It is much the same with *P. lævigata* and its variety *revoluta* Nyl. (Synopsis, p. 385), the last being now taken, and on the same evidence, to be distinct in species from the first. We have here a better marked difference in botanical character,

one which commended itself as sufficient to Floerke, and, at one time, to Borrer; and there seems to be no doubt that this original *P. revoluta* Floerk.! is discrepant from common states of *P. lævigata* in the chemical respect also. Yet this will not hold of the similar American lichen referred to the same variety, at the place cited, by Nylander, which shows no reaction; while, on the other hand, an European condition (Herbarium Krempelh.) is not wanting, associable far less with *revoluta* than with *lævigata*, the evident reaction in which favors the inference that the latter varies possibly in its chemical relations as much as the former; and that the new criterion is after all of no service. In all my numerous European specimens of *P. tiliacea*, the medullary layer is tinged red by the same salt, as stated by Nylander; but only two or three of the much more abundant North American ones show any trace of the reaction: the same discrepancy recurring in the intertropical forms, instanced by the var. *sublævigata* Nyl. (Lindig's Herbarium of New Granada), of which No. 110 of the second collection exhibits the coloration, while No. 736 fails to. Some of the specimens from this continent, showing no change of color, might indeed be referred or rejected to the conterminous *P. lævigata;* but surely not all: and it is safer to infer that the species before us furnishes only another example of the variableness of Lichen-groups in this respect. *P. caperata* is reckoned, by the same authority, among the species the medullary layer of which gives no indication of a red tinge with the reagent. I find yet the contrary the case in North American specimens, as well from Arctic America as from Texas; in Chilian and Peruvian ones; and in one said to be from Spitzbergen (Hookerian Herbarium), almost all these states being also marked by elevated, powdery margins,—as if a var. *ulophylla* (see Acharius) filled in this species an analogous place to the var. *olivetorum* in *P. perlata*,—but some (it is worthy of note) sufficiently normal. *P. Borreri* belongs, it is further said, to the number of species which exhibit the reaction; but none is observable in several well-marked North American specimens in my herbarium, and the same is true of the New Grenada *P. Borreri* Nyl. (Lindig's Herbarium, No. 735). The group represented by *P. physodes* is, on the other hand, set down as not affected by the salt in the way named. *P. Japonica*, of the present writer, belongs none the less to the group, and exhibits a free coloration. So *Dirina* is reckoned generally as displaying "a very distinct erythrinic reaction;" yet the Californian species (*D. Californica*) fails to respond to the test. A pale yellow tinge follows the application to the last-named Lichen, as in many other cases; but in what appears rather a corticoline form of *P. conspersa*, from Louisiana (var. *leucochlora* Nyl.), the change is to bright yellow not without orange, contrasting with the entire want of coloration in common states, and perhaps therefore not unworthy of note in the present discussion.

These results, given with due respect to the experienced authors whose observations have been considered, sufficiently indicate that the writer

inclines to emphasize the doubts with which Dr. Fries has received the supposed new criteria of distinction. It remains none the less likely, from what evidence we have, that the reagents named, capable as they are of instructive application to imperfect fragments of specimens, may sometimes afford clews to affinity where there is little to direct; and thus deserve a place beside the better-known solution of iodine, on our working tables. — E. Tuckerman, *Amherst.*

The Sun-dew a Fly-trap. — I wish to call the attention of botanists to a very humble little plant, the *Drosera rotundifolia*, or common sun-dew, which not only catches flies, but eats them. I was looking early in the spring in a swamp for chrysalids, when I noticed the tiny leaves of the sun-dew, which has beautiful blood-red glandular hairs, each tipped with a glistening dew-drop. The leaves were covered with the wings and legs of gnats. One or two had the hairs gathered into a knot at their centres, and on one a live gnat was struggling hopelessly to escape. I secured two plants and kept them for several weeks by laying the bit of moss on which they grew in a plate supplied every day with water. During this time I fed them with midges, ants, and beefsteak. The tiny drop of dew is glutinous, and any small insect touching them is lost. Every effort to escape but hurries its doom, and in a moment wings and legs are held fast to the tiny bristles.

Now begins the curious part of the affair. All the hairs begin to move towards the insect, but so slowly that their motion is almost imperceptible. In a few hours the hairs touch and cover it with their adhesive points. I placed a piece of raw beefsteak on the centre of a leaf. In twelve hours nearly every hair touched it. They gathered over it in knots and remained so for a day and a half, when they slowly returned to their natural position, leaving the beef a white sodden atom resting on the points of the hairs. I tried it with a bit of paper, but it refused to move for that; then a tiny fly was touched to one of the treacherous dew-drops, smothered, and in a few hours all the ferocious little scarlet hairs had their beaded points upon his body. When the *blossom* bud appeared, the glands no longer secreted the dew, and the leaves lost their brilliant color. — L. A. Millington.

Two Crops of Roses. — Another correspondent has mentioned a monstrosity in roses. I have a Provence rose which for three years in succession has borne numbers of flowers after its usual time of blooming. The late roses generally grow directly out of the old one until the third is produced. Some of them are perfect with the exception of the calyx, which is undeveloped; while others are a confused cluster of pink leaves, at the end of a stout stem. — L. A. M.

A White Wild Columbine. — One of your correspondents has spoken of finding Columbines that were nearly white. I believe they are not uncommon, as I have frequently found not only Columbines but *Lobelia cardinalis* of a delicate white or cream color. — L. A. M.

ZOÖLOGY.

ARE BEES INJURIOUS TO FRUIT? — Dr. H. A. Hagen, late of Königsburg, Prussia, who is an eminent entomologist, and who has paid special attention to the literature of Bees and Bee-keeping, thus writes us regarding this question: —

"I have never known, and find nothing in the literature now at hand to prove that Bees are obnoxious to fruits and to fields. Bees can never use the fields of *red* clover; the corolla is too long for their proboscis. But they are very frequently seen in the fields of white clover, and I have heard that these fields are obnoxious to bees, if shortly before rain has fallen."

APIPHOBIA. — The people of Wenham have voted, by a two-thirds majority, that no bees shall be kept in the town — the vote being directed against an extensive bee-keeper whose stock has been troublesome. Some say the action of the town is of "doubtful constitutionality."— *Boston Journal.*

The good people of Wenham have judged that bee-keeping and fruit-raising are incompatible, and that bees are a nuisance!! We also notice that the bee-keeper "whose stock has been troublesome" advertises in the *Salem Gazette*, his farm for sale, consisting of "three-quarters of an acre of tillage land, containing from seventy-five to one hundred pear trees, besides apple trees. The pear trees, 1867, bore thirty bushels of choice standard fruit." (*Memorandum.* — The bee-keeper himself seems, from the above quotations, to have found *both* fruit-raising and bee-keeping a source of profit!!)

Have we gone back to the Dark Ages, the age of belief in Dragons, "Gorgons and Chimæras dire," Krakens, Unicorns, and Witches and Witchcraft? Are these poor bees to be voted worse than fiends and dragons, about which there is always a sort of tragic interest, and to be adjudged only as "common nuisances," to be abated and extinguished by the ballots of Wenham's "free and independent woters?" This disease, *Apiphobia*, as we may call it, has afflicted mankind before. Among some of its attendant symptoms are intense *bigotry* (sometimes leading to undue persecution);* an unreasoning credulity, so that all sorts of horrible stories regarding these entomological monsters are eagerly believed, and the unfortunate sufferer from these *bee-horrors* finally comes to look at every object with hymenopterous eyes. Musquitoes, for example, look as large as bees, and sting as only a super-infuriated Wenham bee can sting. It has raged fiercely at times in Germany, from the year 1530 up to the year 1800, and now, alas! has broken out among the unfortunate inhabitants of Wenham, Massachusetts, U. S. A. It would be immodest in us to suggest as a preventive against this for-

* We learn that the selectmen of Wenham have ordered the bee-keeper to abate the "nuisance," and take his bees out of town. Can it be possible! and this in enlightened Massachusetts!

midable disease, the daily reading of the NATURALIST, but we can heartily recommend the perusal of the *American Bee Journal*, which is devoted to the habits and natural history of the Honey Bee.

A little knowledge of Natural History is really the only antidote yet discovered against this fell disease. We quote from the *American Bee Journal* for March, the Editor's remarks on the subject of

BEES AND FRUIT BLOSSOMS. — A silly prejudice against bees is entertained by some fruit-growers, based on the notion that the crops of fruit are injuriously affected, both in quality and quantity, by the visits of bees during the blossoming period. A more unfounded notion, or one deriving less support from observation and science, can scarcely be conceived. Yet it regularly looms up once or twice in a century, and creates as much alarm and consternation among the wiseacres, as the appearance of a comet used to do in by-gone days.

Repeated instances of the resuscitation of this prejudice are presented in the history of bee-culture in Germany, especially in the period between 1530 and 1800. On some of these occasions it was so widely prevalent and so rabid in its demonstrations, as to constrain the almost total abandonment of bee-culture in districts where fruit-raising bore sway. To the aid of this came the substitution of cider and beer for the ancient mead or metheglin, as the popular beverage; and amid such opposition and discouragement, bee-culture rapidly sunk to be of very subordinate interest, except in some favorable localities.

In 1774, Count Anthony of Torrings-Seefield, in Bavaria, President of the Academy of Science at Munich, striving to re-introduce bee-culture on his patrimonial estate, found in this generally prevalent prejudice the chief obstacle to success. To overcome it, he labored assiduously to show that bees, far from being injurious, were directly beneficial in the fructification of blossoms — causing the fruit *to set*, by conveying the fertilizing pollen from tree to tree and from flower to flower. He proved moreover, by official family records, that a century earlier, when bees were kept by every tenant on the estate, fruit was abundant; whereas then, when only seven kept bees, and none of these had more than three colonies, fruit was scarcer than ever among his tenantry.

At the Apiarian General Convention, held at Stuttgard, in Wirtemburg, in September, 1858, the subject of honey-yielding crops being under discussion, the celebrated pomologist, Professor Lucas, one of the directors of the Hohenheim Institute, alluding to the prejudice, went on to say, — "Of more importance, however, is an improved management of our fruit-trees. Here the interests of the horticulturist and the bee-keeper combine and run parallel. A judicious pruning of our fruit-trees will cause them to blossom more freely and yield honey more plentifully. I would urge attention to this on those particularly who are both fruit-growers and bee-keepers. A careful and observant bee-keeper at Potsdam writes to me that *his trees yield decidedly larger crops since he has established an apiary in his orchard, and the annual product is now more certain and regular than before*, though his trees had always received due attention."

Some years ago a wealthy lady in Germany established a green-house at considerable cost, and stocked it with a great variety of choice native and exotic fruit-trees — expecting in due time to have remunerating crops. Time passed, and annually there was a superabundance of blossoms, with only very little fruit. Various plans were devised and adopted to bring the trees into bearing, but without success, till it was suggested that the blossoms needed fertilization, and that by means of bees the needed work could be effected. A hive of busy honey-gatherers was introduced next season; the remedy was effectual — there was no longer any difficulty in producing crops there. The bees distributed the pollen, and the *setting* of the fruit followed naturally.

THE MOTTLED OWL. — I think Mr. Samuels has misunderstood my remarks on the nests of owls. What I intended to state was that the *Mottled Owl* never built a nest to my personal knowledge, and I did not state that the *Mottled Owl* occupied the "abandoned nest of a crow or hawk," but I did state that *other species* of owls (of course meaning our local species), when they did occupy a nest at all, inhabited the abandoned nest of a crow or hawk, which they had partially repaired. — AUGUSTUS FOWLER.

An Albino Humming-Bird. — During the last summer a white Humming-bird visited many times a stand of plants on my piazza. I had several opportunities of observing it closely. It *seemed* a trifle larger than the Ruby-throat. The neck and head were of a glossy gold-color. Eyes large, black, and brilliant. After dipping its bill into all the fuschias, it did what I have never seen other Humming-birds do, alighted on a dwarf apple-tree within a few feet of me, and ate the aphides, or plant-lice, just as the sparrows and golden-wrens do. After a hearty meal of insects, it dressed its feathers, spread its wings one by one, and thrust out a very long tongue. — L. A. Millington.

ENTOMOLOGICAL CALENDAR.

In April the injurious insects in the Northern States have scarcely begun their work of destruction, as the buds do not unfold before the first of May. We give an account, however, of some of the *beneficial insects* which are now to be found in grass-lands and in gardens. The farmer should know his true insect friends as well as his insect foes. We introduce to our readers a large family of ground-beetles (*Carabidæ*, from *Carabus*, the name of the typical genus) which prey on those insects largely injurious to crops. A study of the figures will familiarize our readers with the principal forms. They are dark-colored, brown or black, with metallic hues, and are seen in spring, and throughout the summer, running in grass, or lurking under stones and sticks in

Fig. 1.

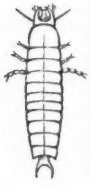

Fig. 3.

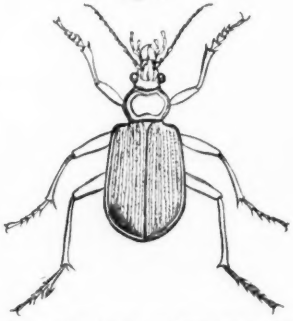

Fig. 2.

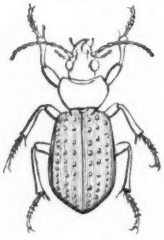

Fig. 4.

damp places, whence they sally forth to hunt by night, when many vegetable-eating insects are most active.

The larvæ are found in much the same situations as the mature beetles. They are elongate, oblong, and rather broad, the terminal ring of the

body being armed with two horny hooks, and having a single fleshy leg beneath, and are usually black in color. The larva of *Calosoma* (*C. calidum*, Fig. 1; Fig. 2, the beetle of *C. calidum* Fabr., and Fig. 3, *C. scrutator* Fabr.) ascends trees to feed on caterpillars, such as the canker-worm. When about to transform to the pupa state, it forms a rude cocoon in the earth. The beetle lies in wait for its prey in shallow pits excavated in pastures. We once saw it fiercely attack a June-bug (*Lachnosterna fusca*) nearly twice its size; it tore open the hard sides of its clumsy and helpless victim with tiger-like ferocity. *Carabus* (Fig. 4, *C. serratus* Say; Fig. 5, pupa of *Carabus auronitens* of Europe, after Westwood) is a closely allied form, with very similar habits.

Fig. 8.

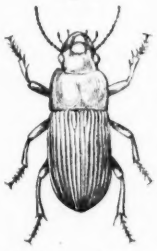

Fig. 5.

Fig. 6.

Fig. 7.

A much smaller form is the curious *Bombardier* beetle, *Brachinus* (Fig. 6, *B. fumans* Linn.), with its narrow head and heart-shaped prothorax. It is remarkable for discharging with quite an explosion from the end of its body a pungent fluid, probably as a protection against its enemies. An allied genus is *Casnonia* (Fig. 7, *C. Pennsylvanica* Dejean) which has a long neck and spotted wing-covers. Fig. 8, *Pangus caliginosus* Fabr., and Fig. 9, *Agonum cupripenne* Say, represent two common forms. The former is black, while the latter is a pretty insect, greenish, with purplish red wing-covers, and black legs.

Fig. 10.

Fig. 9.

Fig. 10, enlarged about three lines, represents a singular larva found by Mr. J. H. Emerton under a stone early in spring. Dr. Leconte, to whom we sent a figure, supposes that it may possibly be a larva of *Harpalus*, or *Pangus caliginosus*. It is evidently a young Carabid. The under side is represented.

In our monthly calendar for 1868, we shall not repeat any facts stated in the calendar given in Vol. I. of the NATURALIST.

CORRESPONDENCE.

E. L. M., New York.—There is no manual of American Entomology* giving a general account of insects and the classification of the North

*The writer has ready for the press, *A Manual of Entomology and Guide to the Study of Insects*, which will be published during the year. It is designed to be a general introduction to the

American species. The following will be found indispensable, in addition to those enumerated in Vol. I, p. 106 and 160 of the NATURALIST:—

A Treatise on the Insects Injurious to Vegetation. By Dr. T. W. Harris. Illustrated. Boston, Nichols & Noyes. Reports (one to eight) on the Noxious and Beneficial Insects of New York. By Dr. Asa Fitch. Published in three volumes. The Practical Entomologist; published by the American Entomological Society of Philadelphia. The Proceedings of the Entomological Society of Philadelphia, Vols. 1–6, now continued under the name of *Transactions*. The Entomological publications of the Smithsonian Institution at Washington, containing works on the Lepidoptera, the Diptera, Coleoptera, and Neuroptera. In these important works are lists of all works relating to American insects, to which we would refer the reader.

Dr. H. Loew, in various European journals, has described many of our Diptera. The British Museum Catalogue of Insects, over fifty volumes in 12mo, describes many of our insects, and is indispensable to students.

L. A. M., Glenn Falls, N. Y.—The Sugar Mite (*Acarus saccharinum*) is found in brown sugar. It is much like the Domestic Mite (*Acarus domesticus* De Geer), which is found in collections of insects and stuffed birds, where it is quite destructive. *Acarus farinæ* is found in flour and food, and the Itch-insect (*Acarus scabies* Fabricius) forms by its irritating presence little pustules in the more protected parts of the hand and elsewhere. The Red Spider (*Acarus tellarius*) is found on house-plants. They are best destroyed by sprinkling sulphur over the leaves they infest.

BOOKS RECEIVED.

Half-yearly Abstract of Medical Sciences. July to December, 1867. Philadelphia. 8vo.

Rust, Smut, Mildew, and Mould. An Introduction to the Study of Microscopic Fungi. By M. C. Cooke. 12mo. London, 1865. R. Hardwicke. With nearly three hundred figures by J. C. Sowerby.

Manual of Botanic Terms. By M. C. Cooke. London. R. Hardwicke. With illustrations.

A Fern Book for Everybody. Containing all the British Ferns. By M. C. Cooke. Illustrated. London, 1867. F. Warne & Co.

A Plain and Easy Account of British Fungi, with Descriptions of the Esculent and Poisonous Species, Details of the Principles of Scientific Classification, and a Tabular arrangement of Orders and Genera. By M. C. Cooke. With twenty-four colored plates. 12mo. London, 1862. R. Hardwicke.

Our Reptiles: A Plain and Easy Account of the Lizards, Snakes, Newts, Toads, Frogs, and Tortoises indigenous to Great Britain. By M. C. Cooke. With illustrations. 12mo. London, 1865. R. Hardwicke.

Hardwicke's Science-Gossip for 1867. London, 1868. Royal 8vo. R. Hardwicke.

Land and Water. January 18, 25, February 1. London.

The Field. February 1, 8, 15. London.

Chemical News. March. New York.

Cosmos. February 1, 22. Paris.

American Bee Journal. March. Washington.

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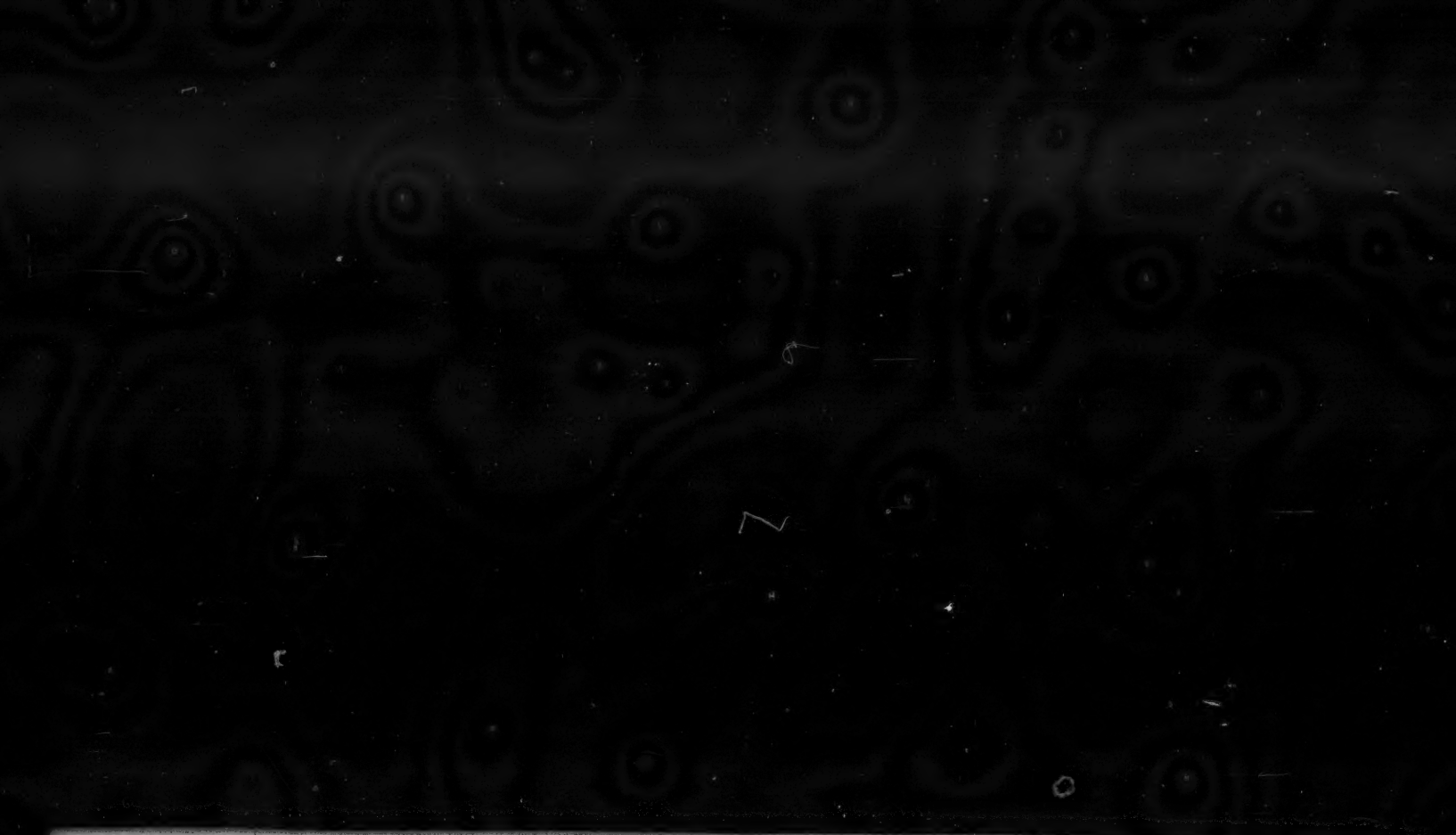
study of Entomology, arranged for the use of Schools, Colleges, and Agriculturists. It will consist of upwards of four hundred pages, long primer type, with nearly four hundred cuts. It will contain short descriptions and figures of nearly all our most destructive and beneficial insects, and those useful in the arts, with remedies against the attacks of the noxious species. It is designed to be a *popular* book, written in plain language, and free as possible from technicalities, and furnished with a glossary. We shall endeavor to make it of use to the beginner in the study of insects, and especially to farmers and fruit-raisers.—A. S. P.